plating

JOURNAL OF THE AMERICAN ELECTROPLATERS' SOCIETY

IN THIS ISSUE

How Versatile Application Techniques for Gold Solve Aircraft and Missile Problems

Fatigue Studies of Plated Hot Work Tool Steels

Copper Electroforming of Heat Sinks for Missile Nose Cones

Outline of the Chemistry Involved in the Process of Catalytic Nickel Deposition from Aqueous Solution

AC Ripple in Rectifier Output

PLATING MAGAZINE

AMERICAN ELECTROPLATERS' SOCIETY

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NOVEMBER • 1959

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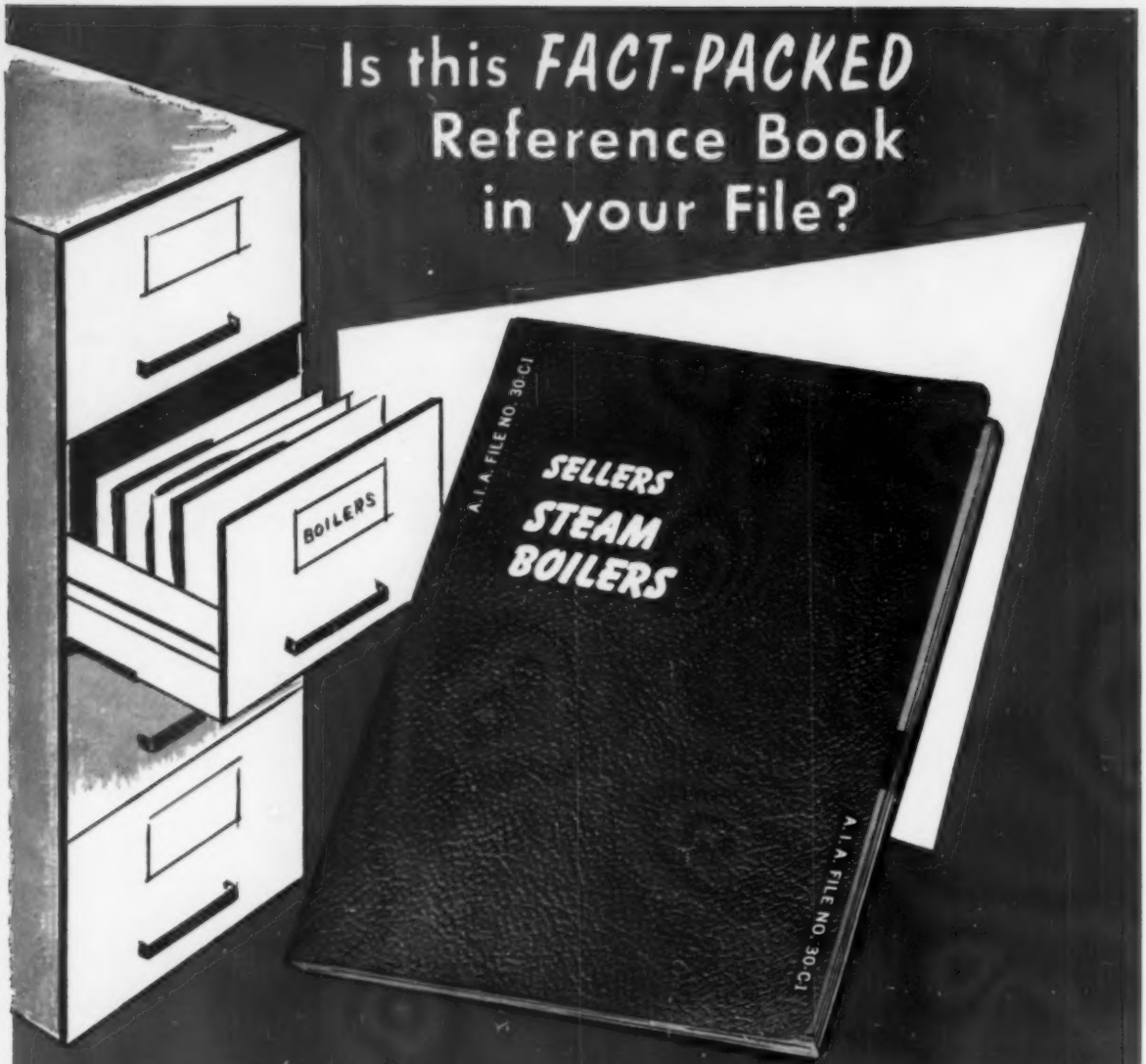

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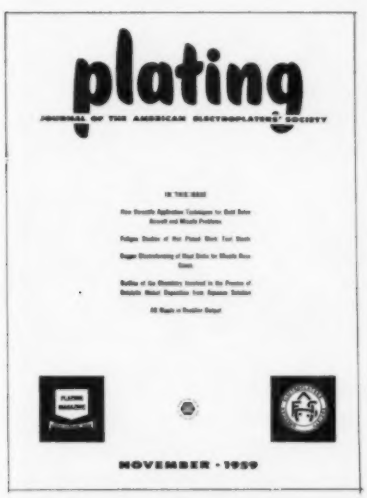
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JOURNAL OF THE AMERICAN ELECTROPLATERS' SOCIETY

NOVEMBER 1959 — **Vol. 46, No. 11**

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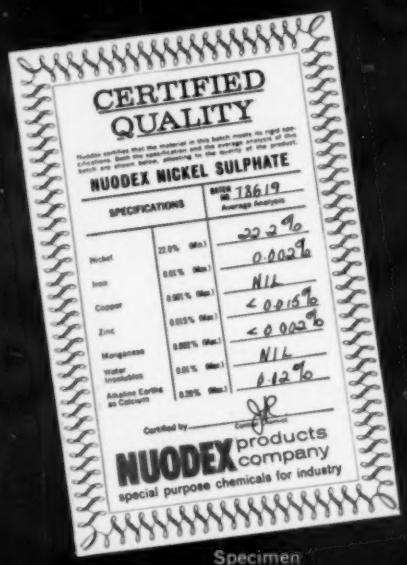
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EDITORIAL

DO IT NOW

ONE OF THE MOST SIGNIFICANT evidences of the half-century progress of American Electroplaters' Society, Inc. (AES) that came into focus at the GOLDEN JUBILEE Convention in Detroit June 15–19, 1959 was the creation of the Charles Henry Proctor Memorial Leadership Award annually to be donated by the daughter of AES's founding father in his memory.

For years, the Society through its eight annual Paper Awards, including the Carl E. Heussner AES Gold Medal, has been recognizing achievement in enriching knowledge in electroplating, metal finishing and allied arts through scientific and technical papers published in AES's PLATING MAGAZINE or in its annual book, TECHNICAL PROCEEDINGS. More recently, it launched its new annual AES Scientific Achievement Award honoring long-time, superior scientific service to AES and the industry by an AES member eminent in science. And now, through its new annual Charles Henry Proctor Memorial Leadership Award, the AES will henceforth recognize and honor that AES member in good standing who during the year demonstrated the most conspicuous leadership qualities among nominees by AES Branches and AES Committees in furthering the objectives of the Society or enhancing its dignity, prestige or progress.

The very first selection of a Proctor Leadership Award winner will be made in 1959–1960, and his identity will be announced at the Farewell Banquet of the Los Angeles Annual Convention, July 28, 1960. He will receive a $150 cash award, an inscribed and illuminated scroll and, of course, suitable recognition in PLATING MAGAZINE and in TECHNICAL PROCEEDINGS.

The mission of each AES Branch and of each AES Committee that will soon be asked to name candidates will be to spot and nominate that man who, in their judgment, most deserves that Award because of the magnitude of his administrative, membership promotion, public relations, educational or other outstanding deed in behalf of AES and its members. For Branches and Committees, that will be a duty important not only to the Society, but also to the stalwarts who are doing so much to further its welfare and progress. In the latter connection, this little poem "DO IT NOW" by Berton Braley, first published by the Newspaper Enterprise Association some forty years ago and since then reprinted in dozens of anthologies, is certainly apt:

> If with pleasure you are viewing, any work a man is doing,
> If you like him or you love him, tell him now.
> Don't withhold your approbation, till the parson makes oration
> As he lies with snowy lilies on his brow.
> For no matter how you shout it, he won't really care about it,
> He won't know how many teardrops you have shed.
> If you think that praise is due him, now's the time to slip it to him,
> For he cannot read his tombstone when he's dead.

So when the Return Sheet for AES Branch and AES Committee nominations for the Charles Henry Proctor Memorial Leadership Award for 1959–1960 soon reaches you, do look around, spot your man, and nominate him. In the sense of Author Braley, "DO IT NOW".

Herberth E. Head
Past President

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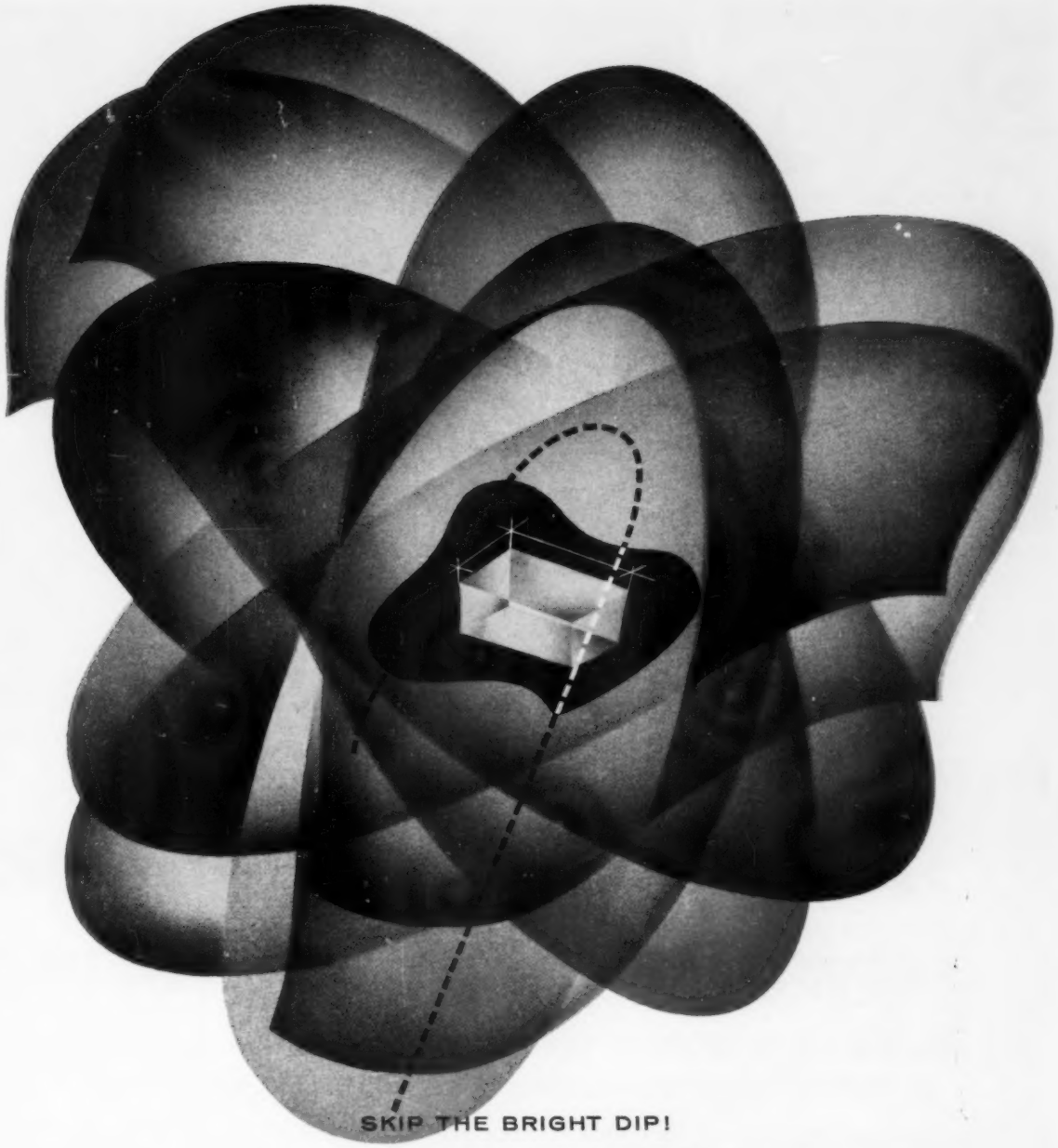

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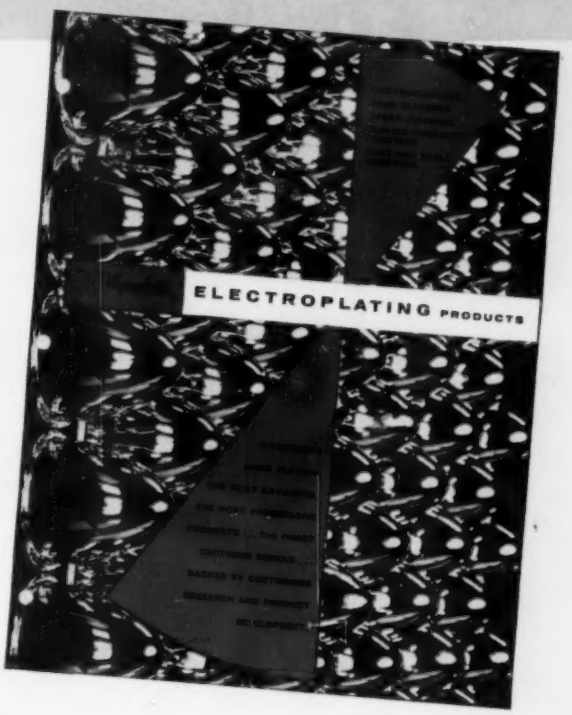

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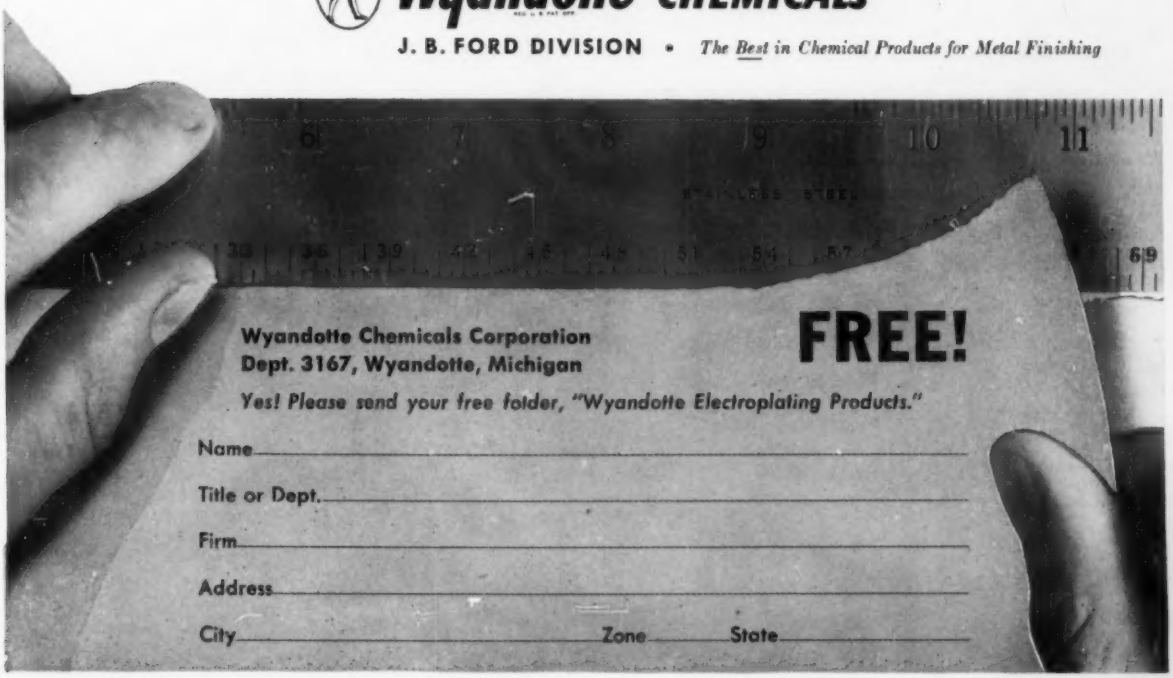

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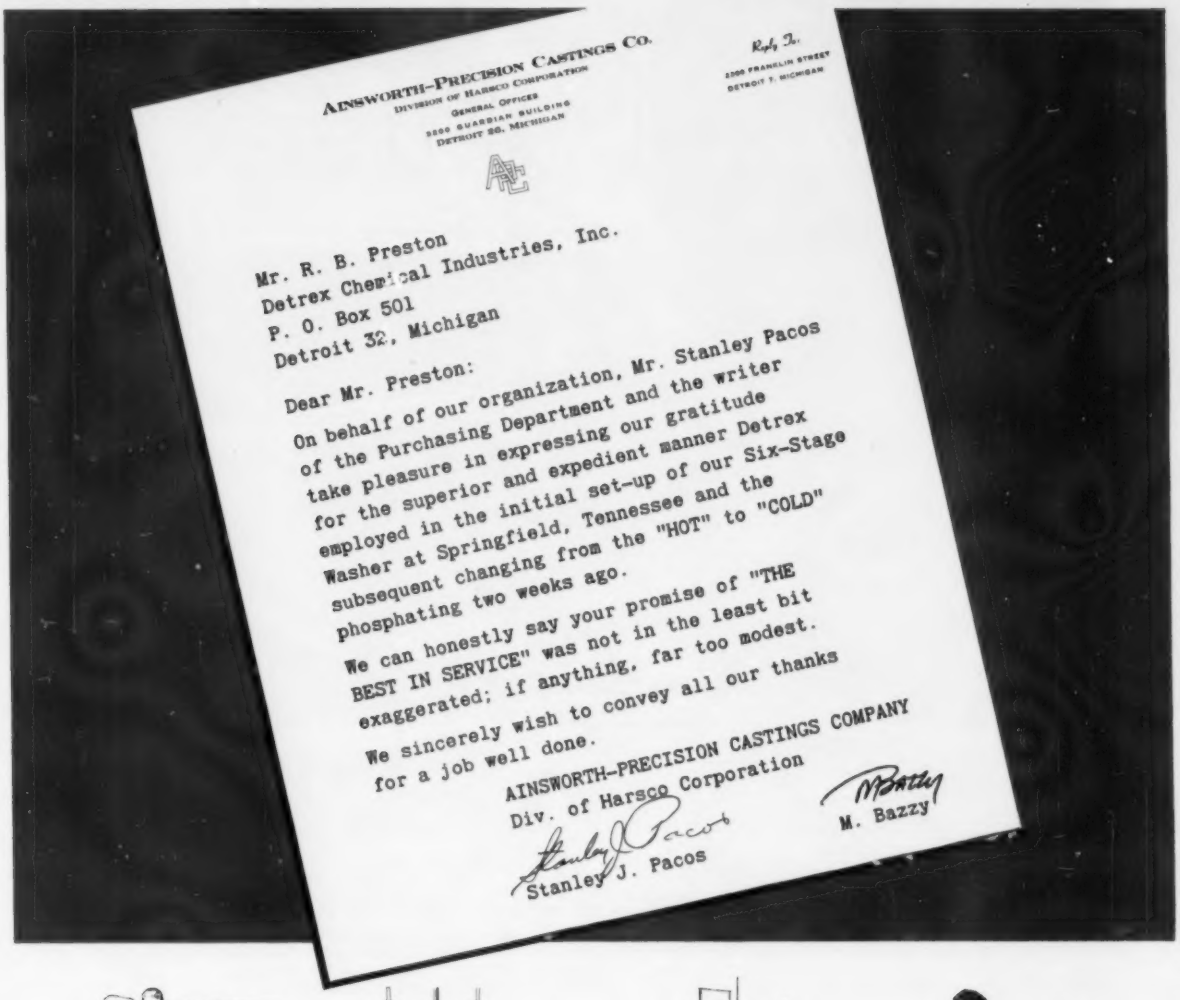

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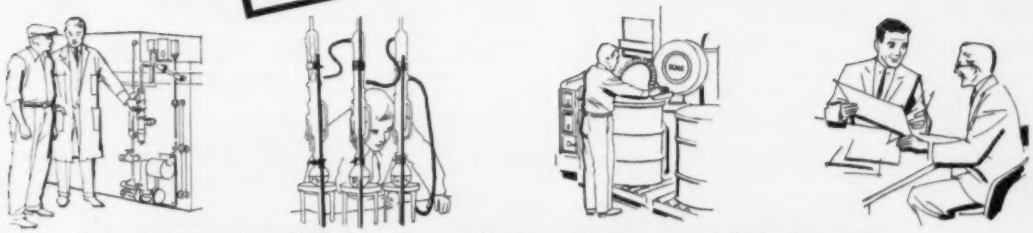
Stanley J. Pacos

M. Bazzy



Detrex has the men, the methods and the materials to increase efficiency and reduce costs of any metal cleaning or processing operation.

DETREX CHEMICAL INDUSTRIES, INC.
Box 501, Dept. P-119, Detroit 32, Michigan

Harshaw Perflow-Perglow Duplex Nickel Plating Process
Continues to Make Startling Advances

now well over **one million**

in operation

There is no more graphic way to demonstrate the superiority of this outstanding Harshaw development than to *state the facts:*

1. *ALL* 1959 domestic autos used external parts plated with Harshaw Perflow-Perglow Duplex Nickel (*On some models as high as 90% of the external parts.*)
2. Over Three Hundred Thousand gallons of Perflow-Perglow Duplex Nickel were installed between June 15 and September 15, 1959!

This is an amazing growth record, pointing up the undeniable fact that automobile manufacturers and their suppliers turn to the process which promises maximum corrosion resistance for their products—and in an ever-increasing wave they are turning to the Harshaw Perflow-Perglow Duplex Nickel Plating Process.

The Harshaw Chemical Company after years of research and development work was the first to find that a *sulfur-free* nickel offers greater corrosion resistance. This fact led to the development of the Harshaw Perflow nickel plating process. Further research showed that use of the sulfur-free Perflow nickel deposit as a base coating, followed by a bright nickel deposit from a *compatible* bath, would give a Duplex deposit with a further improvement of corrosion resistance. Performance data, by both accelerated tests and outdoor exposure, from leading automobile manufacturers and parts suppliers indicate that the Harshaw Perflow-Perglow Duplex nickel plate is comparable to and frequently better than, buffed gray nickel and is unequalled by any bright nickel. We shall be happy to discuss this process with you in person, or by phone or letter. *Write for our free booklet, "Harshaw's Complete Service to The Plating Industry."*

MANY OTHER ADVANTAGES

1. Exceptionally high plating speeds—with air or mechanical agitation.
2. Excellent Chrome Coverage.
3. Unsurpassed Leveling Characteristics.
4. Outstanding Brightness.
5. High Tolerance to Impurities.
6. Excellent Adhesion.
7. Excellent Ductility at Full Brightness.
8. Simplified Control—Stable over extended periods of operation.
9. Controlled Stress.
10. Uniform Protective and Decorative plate on both steel and zinc die castings.

THE HARSHAW CHEMICAL CO.
1945 EAST 97TH STREET • CLEVELAND 6, OHIO

Chicago • Cincinnati • Cleveland • Detroit • Los Angeles
Houston • Hastings-On-Hudson • Philadelphia • Pittsburgh

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1112.

NEW Fulflo PLATING FILTER cuts maintenance costs in half

The new Fulflo Rubber-Lined Steel Filter for plating saves you money in servicing and cleaning.

In addition to reduced maintenance costs you get even more savings in the low initial cost.

So look into the new Fulflo Plating Filter — available in six sizes, with from 6 to 60 Honeycomb Filter Tubes, for capacities up to 18,000 gph.

For new folder, write to Department PL

Easier to Service: New Plating Filter is easier to service because of the new swing-bolt cover. Just loosen the bolts, swing them out of the way, and lift off the cover. In a matter of minutes, you quickly change the patented Honeycomb Filter Tubes.

Easier to Clean: Filter is easier to clean because of the new bottom outlet. By simply adding a "T" connection and drain valve, you quickly clean the entire vessel.

COMMERCIAL FILTERS CORPORATION
MELROSE 76, MASSACHUSETTS
PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

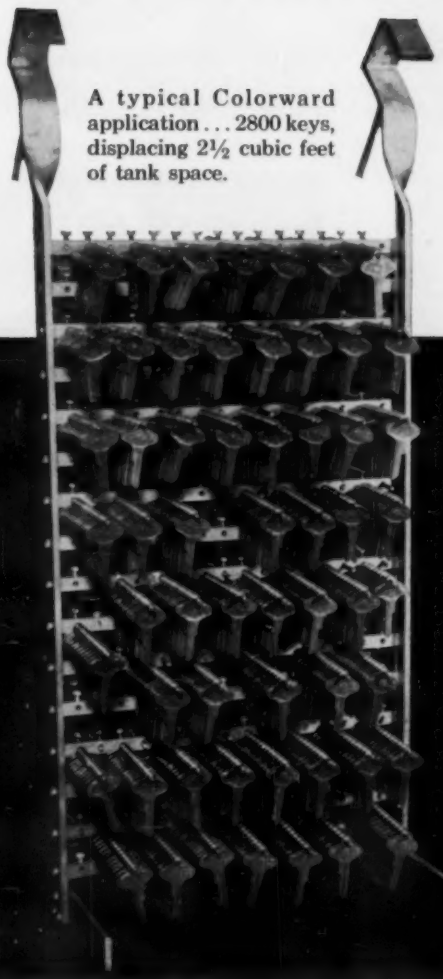
MICRO-CLARITY AT MINIMUM COST

Fulflo FILTERS — *with genuine Honeycomb Filter Tubes for controlled micro-clarity of industrial fluids.*

CFC FILTERS — *Selective filtration of oils • water-oil separators • magnetic separators • pre-coat filters • coolant clarifiers • automatic tubular conveyors.*

A REVOLUTIONARY, NEW PROCESS

CUTS PLATING AND ANODIZING COSTS 33% TO 50%



A typical Colorward application... 2800 keys, displacing 2½ cubic feet of tank space.

SAVE TIME! SAVE SPACE! SAVE MAN HOURS!

Save money, motion and material with Colorward's revolutionary new work holding process. Now, mass immersion of small objects is possible in remarkably small space, with actual improvement in quality... at savings up to 50% over present systems. The patented Colorward process can be licensed on a volume or monthly basis. Our engineers will adapt the Colorward process to your needs and equipment. Your inquiry is invited without obligation.

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Gentlemen:
We are interested in finding out more about the Colorward process.
Please contact us.

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COMPANY_____

ADDRESS_____

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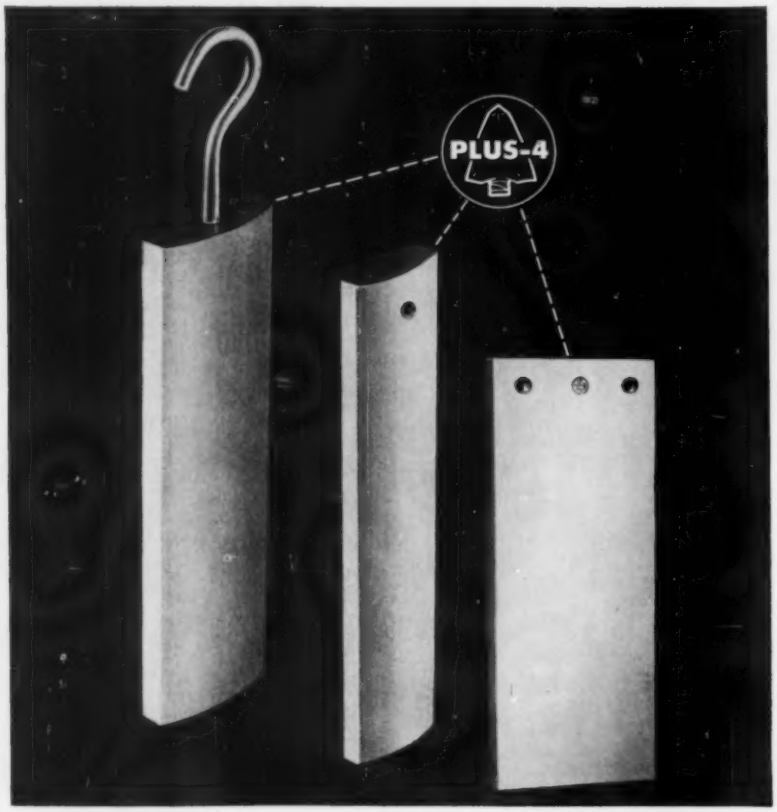
WHATEVER FORM OR SIZE YOU NEED

there are "Plus-4"® (Phosphorized Copper) Anodes to help you cut the costs of acid-copper electroplating—at the same price as ETP copper anodes



"Plus-4" Anodes in commercial use in practically all types of acid-copper electroplating have proved their advantages over wrought or cast electrolytic tough pitch copper anodes. The four advantages indicated by the name are:

+ 1 No anode sludge (no "bagging" or diaphragms required).
+ 2 No copper build-up in the solution.
+ 3 Smooth, heavy cathode deposits.
+ 4 Up to 15% more cathode deposit.

THE REASON for the elimination of sludge formation is that an anode of phosphorized copper develops an adherent dark brown film during electrolysis, which prevents the formation of free copper particles, but which in no way interferes with the plating operation or increases the electrical resistance of the bath. The phosphorized copper anode also corrodes more evenly, depositing more copper per pound on the cathode; gives a smooth, heavy deposit free from roughness due to lodgment of copper sludge particles; and leaves a small, compact "fish." There is no copper sludge or build-up of copper sulfate in the electrolyte.

WRITE FOR INFORMATION on how you can obtain a test quantity to supply one tank. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Toronto 14, Ontario.

59107

FORGED BALL ANODES

Anaconda ETP Copper Ball Anodes, used widely in cyanide plating, are cold forged from wrought metal. The result is a homogeneous, fine-grain structure, free from voids. Consequently they corrode very uniformly without disintegration. The balls are 2" diameter and weigh 1¼ pounds each. Identify them by the spearhead trademark.

ANACONDA®
"PLUS-4" ANODES
Phosphorized Copper

Made by The American Brass Company

NO HALF-BAKED PROTECTION

with Unichrome Coating 218X

That's one of its advantages...

An exclusive built-in "cure indicator" in Unichrome Coating 218X assures extra service life for your racks. In baking, this vinyl plastisol coating changes color from bright green to olive green. A uniform olive green color shows that 218X is fully cured and ready to deliver all advantages for which it is noted — toughness; outstanding resistance to all plating and cleaning solutions, even vapor degreasing cycles; and the resiliency to bounce back after hard use.

Platers have been saving maintenance money for over 10 years now with Coating 218X... first in the field. They have found that *using the best quality at the outset saves most money in the long run.*

Are you taking advantage of the coating that stands out on all *five* major counts? Send for details.

Are you using the rack coating that gives you ALL FIVE?

1. *Built-in cure indicator assures maximum performance*
2. *No contamination of plating baths*
3. *Ability to be rebaked for patching*
4. *Nationwide set-up of expert applicators*
5. *Highly qualified technical service*

UNICHROME

First name in plastisols for all plating purposes...

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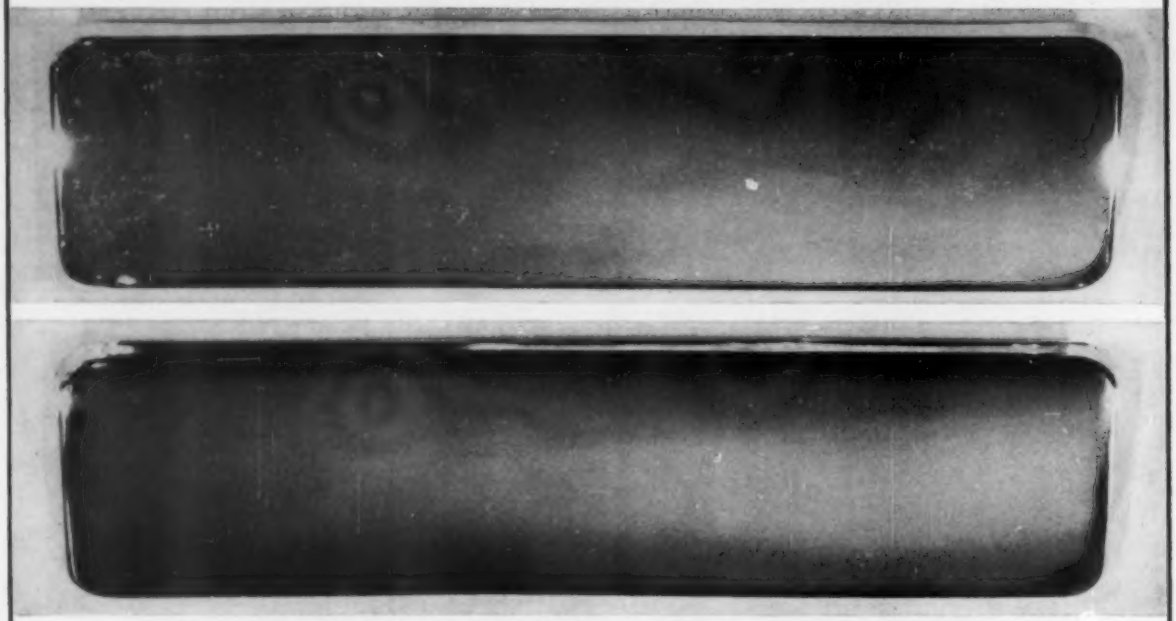
The Difference is *Soak Cleaning!*



These unretouched photos show plated zinc die-cast bars. *Top Photo:* Plating defects are visible on a bar precleaned with a conventional soak cleaner. *Bottom Photo:* Note the bright, lustrous, defect-free plate of the bar precleaned with Kelite SUPERSOLV as the soak cleaner.

For *bright, defect-free* die-cast plate . . .

Use Kelite SUPERSOLV as the Soak Cleaner prior to electrocleaning.

• What SUPERSOLV* is . . .

SUPERSOLV is a non-etch, non-passivating alkaline soak cleaner for zinc-base die-cast parts.

• What SUPERSOLV* does . . .

Used at a concentration of 5 oz./gal. at 160° to 170° F., SUPERSOLV removes mineral oils, buffing compositions and shop soils in a 1 to 2-minute soak cycle without sensitizing or staining the parts, or making them subject to roughness after electrocleaning and acid dip. The result is defect-free plate of improved brightness and lustre.

WRITE FOR PROCESS DETAILS ABOUT A TYPICAL ZINC-BASE DIE-CAST CLEANING CYCLE USING SUPERSOLV

*Patented, U. S. Patent Office

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KELITE CORPORATION

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MUTUAL CHROMIC ACID

Sunbeam tops off good construction and design with smart, sturdy chrome plate to win consumer favor for its sparkling line of appliances. Mutual® Chromic Acid and Sunbeam plating technique team up for a brilliant finish.

Mutual Chromic Acid is always 99.75% pure – or better. Its low sulfate content (less than 0.1%) makes it easier for you to control the acid-sulfate ratio of your plating bath. This safeguards against plating difficulties—and expensive rejects!

To learn more about these and other advantages of Mutual Chromic Acid, send coupon for our free booklet, "Chromium Chemicals." Our Technical Service Staff will also be happy to answer your questions.

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SOLVAY PROCESS DIVISION
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MUTUAL chromium chemicals are available through dealers and SOLVAY branch offices located in major centers from coast to coast.

8-119

SOLVAY PROCESS DIVISION
ALLIED CHEMICAL CORPORATION
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☐ Send Bulletin 52, "Chromium Chemicals"
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Company_____
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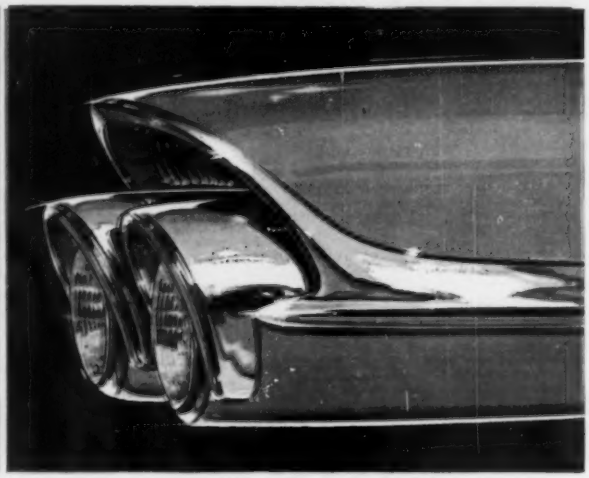
Half a century apart . . .

both finished by Acme machines!

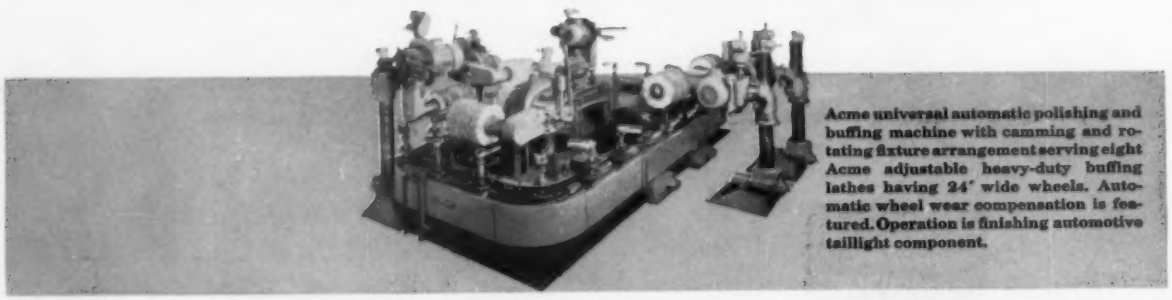


Even in 1910, part of an owner's pride in his car lay in gleaming brightwork. But polishing and buffing the shiny metal that he loved so well caused manufacturers plenty of headaches. And so they turned to Acme—and Acme has continued to supply the answers to their finishing problems.

Today, Acme engineers combine standard units with a variety of accessories to make custom polishing and buffing machines. Large corporations and small job shops alike use Acme machines to reduce rejects, increase production volume, machine finish odd-shaped pieces.

Every year of its history, Acme has encountered new finishing requirements—each an individual problem—and solved them. Chances are, we can solve your problem, too. Send for illustrated 16-page catalog today.

50 years of *Polishing Off* your finishing problems

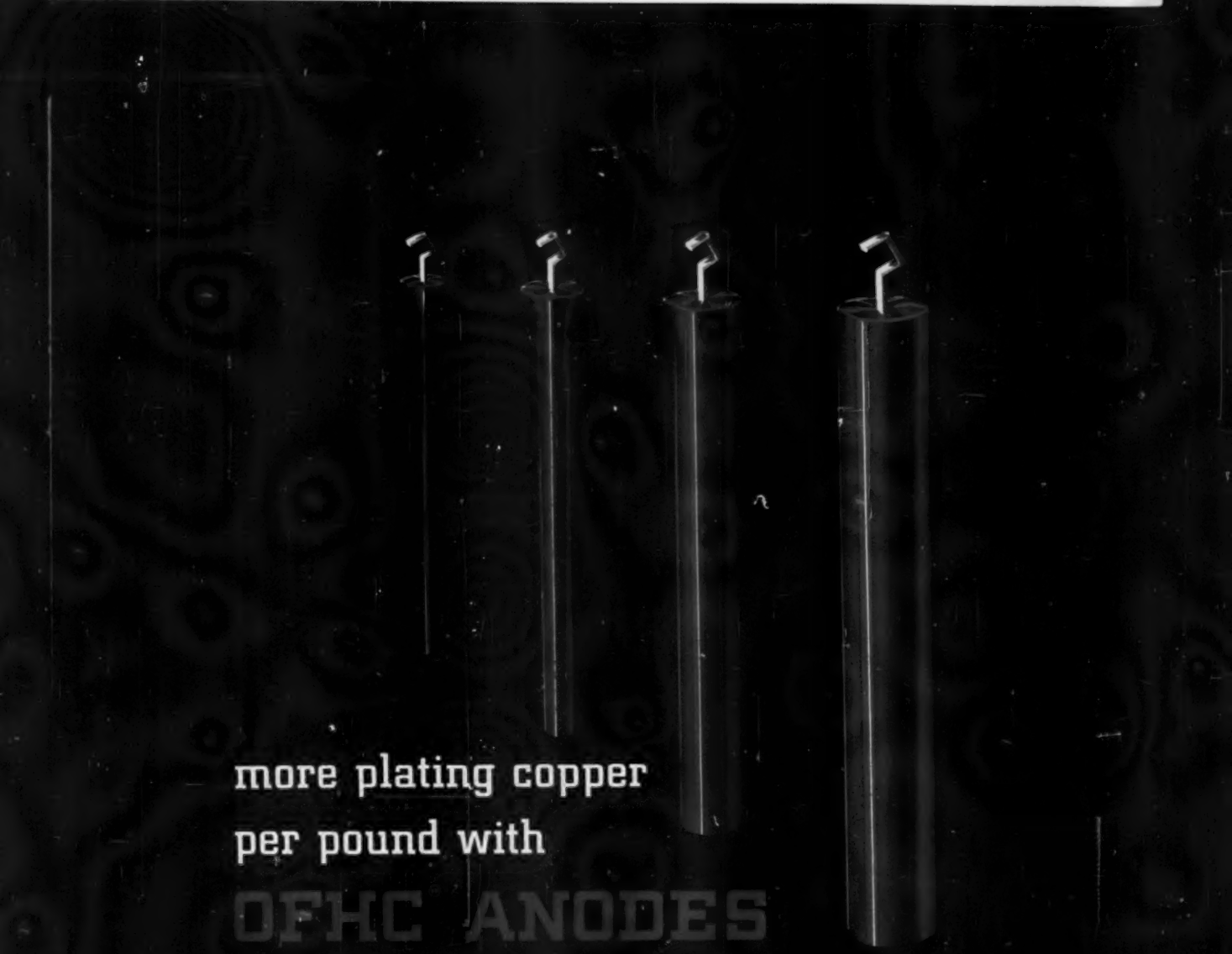


Acme universal automatic polishing and buffing machine with camming and rotating fixture arrangement serving eight Acme adjustable heavy-duty buffing lathes having 24" wide wheels. Automatic wheel wear compensation is featured. Operation is finishing automotive taillight component.

ACME MANUFACTURING COMPANY

1400 E. 9 MILE ROAD, DETROIT 20, MICHIGAN

LEADING PRODUCERS OF AUTOMATIC POLISHING AND BUFFING EQUIPMENT SINCE 1910



more plating copper per pound with OFHC ANODES

An ever-increasing number of platers are discovering that use of OFHC Anodes reduces anode consumption for a given amount of coverage and thickness. The reason: OFHC Anodes are the purest copper anodes produced— 99.99+% copper, completely free of oxides, and uncontaminated by residual deoxidants. Their density is equal to that of rolled anodes. Purity and density add up to *more usable plating copper per pound of anode.*

In addition, OFHC Anodes dissolve uniformly, right up to the solution level. This of course cuts scrap loss, means less down-time for scrap removal and anode replacement.

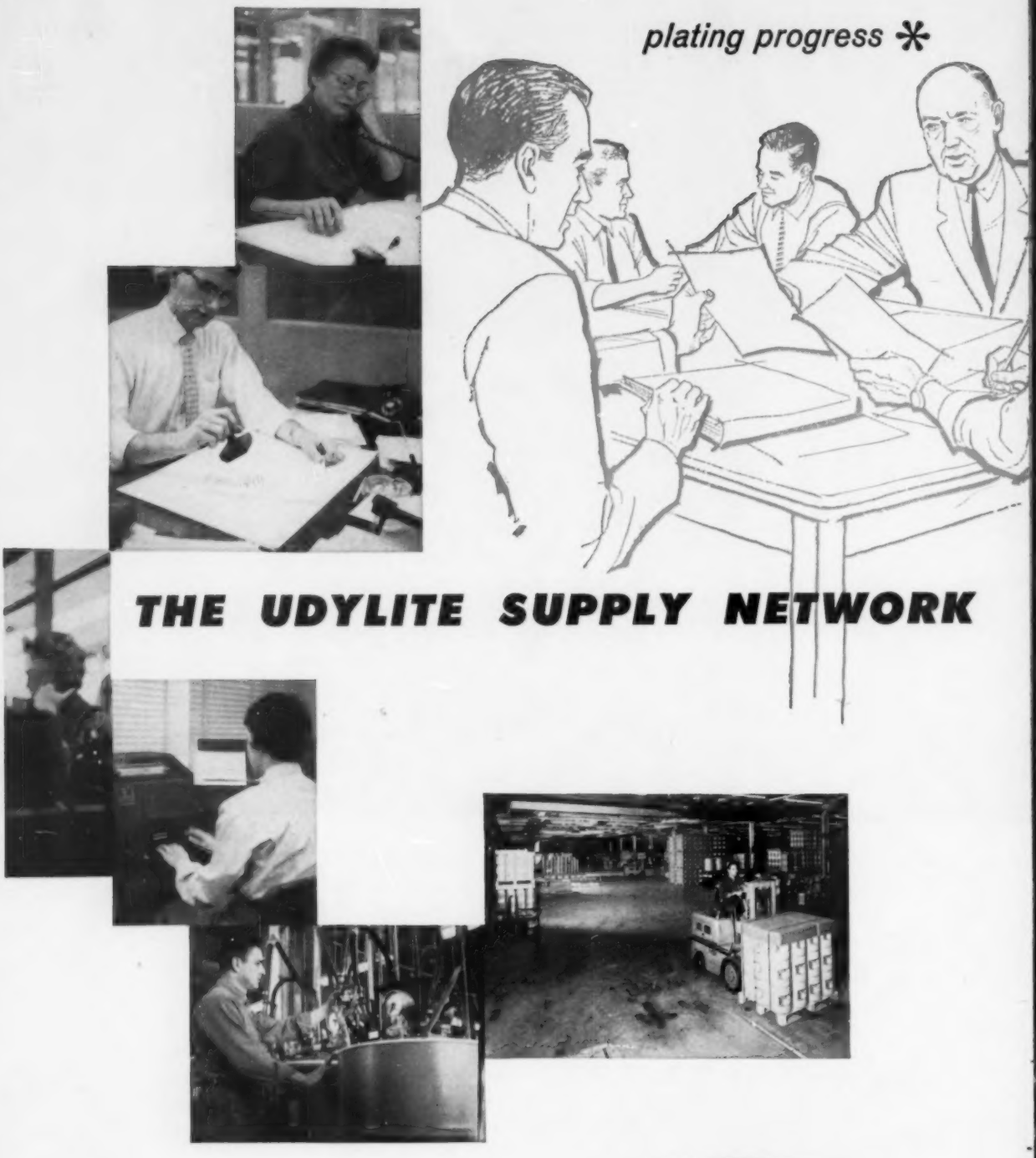
Free technical publications to help you obtain better plating — and at the same time lower costs—are available from your OFHC Anode distributor, or directly from AMCO Technical Service Section. Ask for them today.

AMCO DIVISION
American Metal Climax, Inc.
61 Broadway, New York 6, N.Y.

OFHC Anodes—Made Only by American Metal Climax—are Sold by Leading Plating-Supply Distributors Everywhere.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 1120.

plating progress ✻



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world's largest plating supplier

the **udylite**

corporation

detroit 11, michigan

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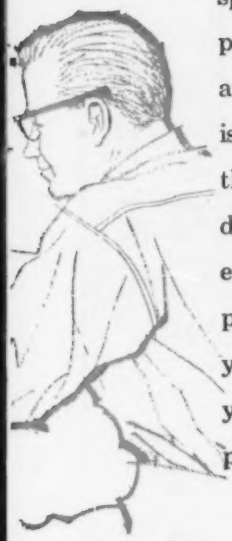

Telephone, teletype and cable, a globe-circling network of depots, the speed of jet-age transportation are all at your command when you order plating supplies from Udylite. The supplies service team comprising a large and intricate complex of communications, warehousing, and personnel is set in motion with the receipt of your order. What you *get* is the finest quality, the newest exclusive processes, in the most advanced packaging available, delivered with exactness, and speed. Within twenty-four hours—even less if necessary—your order can be on its way to you from the nearest point of availability. In time to keep your production line moving you receive your Udylite supplies, of quality, weight and price you know you can depend upon. This is indeed "worry-free" buying provided for you by Udylite.

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...helps guarantee your production quotas

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Black Oxide Finish

All original claims for the performance of Nickel Pentrate have been dwarfed by reports from users. It's faster. It gives deeper, more uniform blackening. It provides better corrosion protection and more abrasion resistance. There's less dragout. In every test, Nickel Pentrate has proven its superiority in every way.

Nickel Pentrate is the only one-bath black oxide finishing salt in the market containing nickel. Fully covered by U. S. and foreign patents, it is readily available to improve the quality of your black oxide finishing of steel and at the same time hold down production costs.

Send now for descriptive literature giving the complete story of Nickel Pentrate and how it can help you in your business.

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Be Ahead of the Rest

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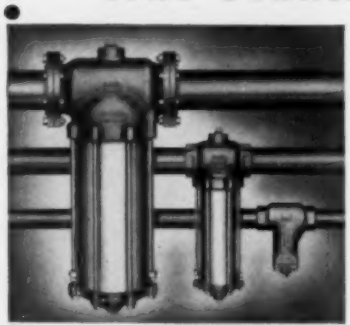

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in stainless steel, cast iron and brass

A complete range of capacities in ¼" to 4" female pipe connection sizes . . . and in 3" to 6" flange connection sizes. Keeps lines clear for efficient operation. Easily flushed.

TOP PERFORMANCE DESIGN

Screen area so large that strainers will take 75% blocking with less than ½ lb. pressure drop under normal flow conditions. Top and bottom flange collars on screen give seal fit and rigidity.

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WRITE FOR your free copy of BULLETIN 94 ...gives complete information

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ANOTHER ACHIEVEMENT OF GENERAL INSTRUMENT CORPORATION

Tri-Amp

the only selenium rectifier with

NO ARTIFICIAL BARRIER LAYER

plus / superior overload characteristics • higher current ratings • lower forward voltage drop • no sudden failures • no special protective devices required • smaller size • operate in parallel or in series without special precautions

Tri-Amp is a new and completely different concept in selenium. No artificial barrier layer of any kind is used, thus eliminating the cause of aging and high voltage drop. Result is the finest rectifier ever made.

Rectification in the Radio Receptor Tri-Amp is accomplished through a P-N junction formed by a closely controlled diffusion process involving the use of cadmium-selenide and tellurium. We'll be glad to send you more complete information on this important development. Write today to Section PL-3.

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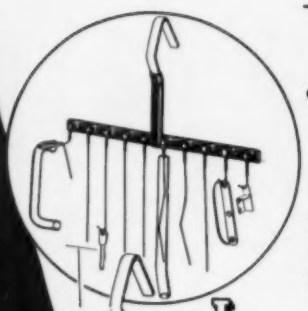
New, Ready Made Mass-produced *Economy* Plating Racks



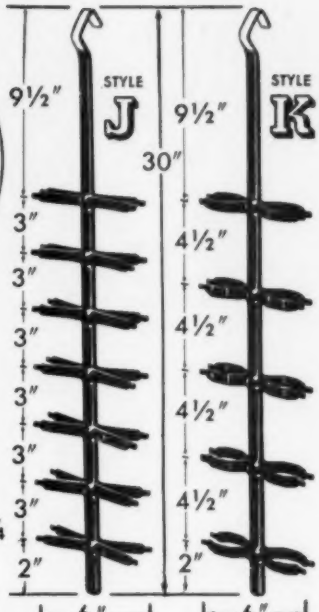
STYLE **L**

7⅜

8¼

14½

$4.50

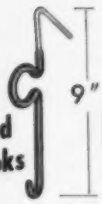


Tips 1/16x1/2" **$6.50**

Tips 1/16x1/2" **$5.75**

36" lengths available

STYLE **M**



9"

Insulated "S" Hooks

¼" copper rod heavy plastisol coat

Less than 100, $.45

100 or more, .40

available in ⅛" rod.

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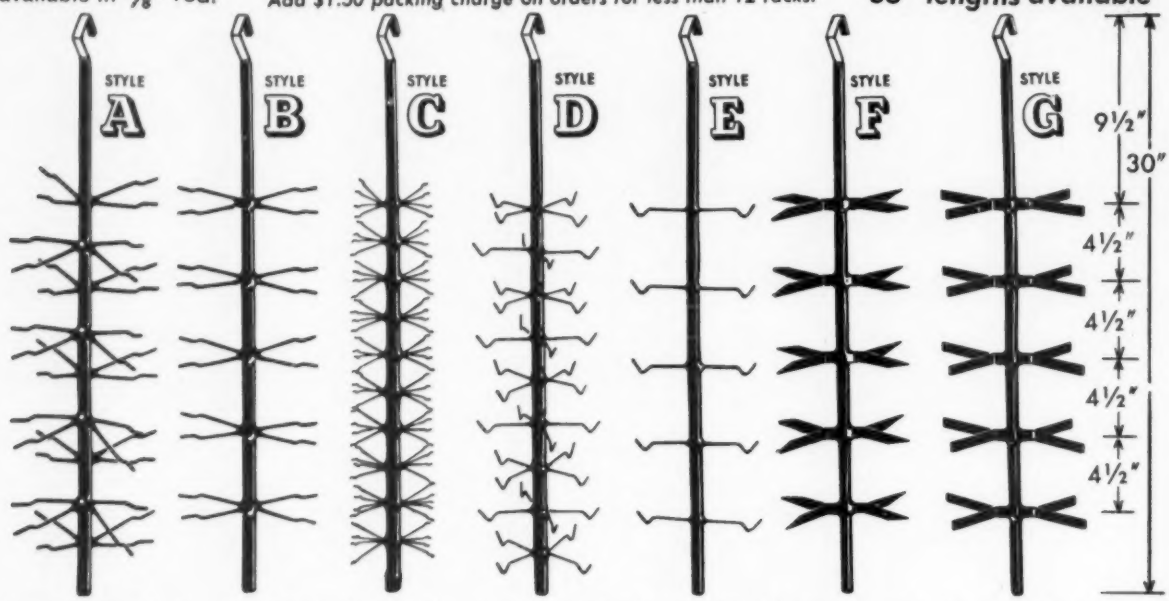
$2.45

Straight .093 dia. phosphor bronze wires; 8" long, 1½" centers. Wires easily shaped or shortened.

Add $1.50 packing charge on orders for less than 12 racks.



A	B	C	D	E	F	G
6½"	7½"	4½"	6½"	6½"	7½"	7½"
Tips .114" dia.	Tips .114" dia.	Tips 1/16" dia.	Tips 3/32" dia.	Tips 3/32" dia.	Tips 1/16x1/2"	Tips 1/16x1/2"
$5.78	**$4.77**	**$6.00**	**$5.83**	**$4.42**	**$5.84**	**$5.69**

Spines one-piece solid copper round cornered and sand blasted. Tips phosphor bronze, riveted to spine and soldered when necessary for complete rigidity. Coated after assembly with BELKE Universal Plastic.

Belke MANUFACTURING COMPANY

947 Cicero Ave., Chicago 51, Ill.

TRADE MARK

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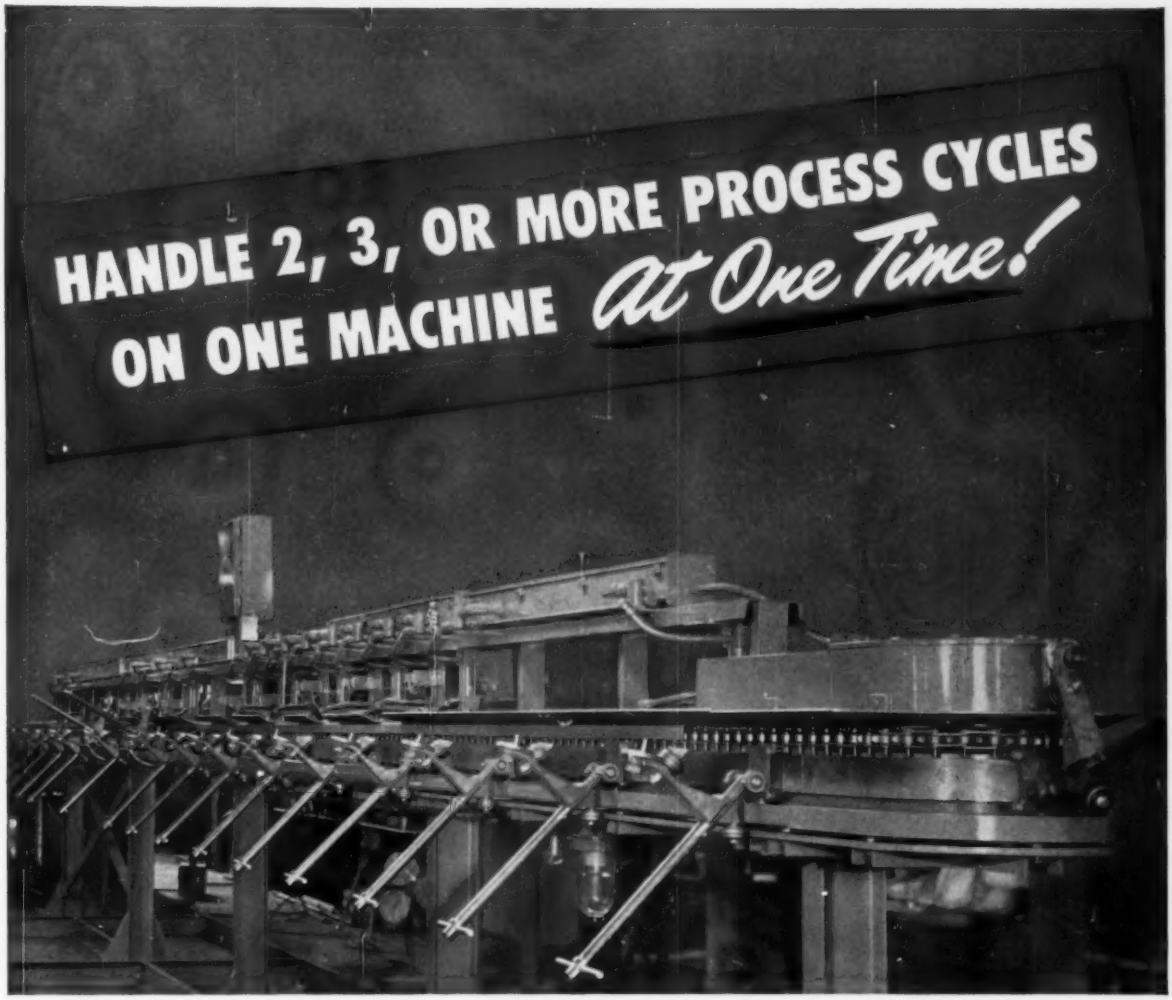

LASALCO'S *Select-O-Matic*

MULTIPLE PROCESS PLATER

Another Lasalco development that offers the industry the last word in *fully automatic* plating!

With the new Select-O-Matic, the operator simply selects the desired process cycle for individual racks, when loading the machine, merely by turning a dial on the carrier. From that point, the rack *automatically* travels through the entire selected cycle without further attention.

A single Select-O-Matic plater, manned by one operator, will handle several various processes simultaneously. Different machines for each process are eliminated—original investment in equipment is greatly reduced—much less floor space is needed—maintenance is cut to an absolute minimum.

The Select-O-Matic is easily adaptable to any operation. Tell Lasalco about *your* operation and requirements to learn what this new machine can do for *your* production and profits.

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REPORT NO. 2 / ON LOWERING TODAY'S COST OF PRODUCTION

Improved electrocleaning of recesses and low current density areas

Controlling foam, lengthening solution life

Despite careful racking and well-planned production, deep recesses and places of normally low current density on intricately shaped parts are always trouble spots.

Diversey electrocleaners were specially fortified with exceptionally high wetting and emulsifying powers to do an effective job at those "problem places." This chemical cleaning supplements high current carrying capacities to give more efficient cleaning in a shorter time. Work emerges waterbreak-free and smut-free, ready for subsequent baths.

You can also depend on Diversey electrocleaner solutions for longer-lasting cleaning power. Greater contamination capacity enables you to use solutions long after ordinary solutions have to be dumped because of heavy soil accumulations.

Controlled foaming is an added safety feature of Diversey electrocleaning. The limited foam blanket serves as a safeguard against explosion dangers even in those occasional cases where current density is stepped up to speed production. When used according to recommendations, Diversey electrocleaners operate safely through a wide range of current densities . . . always exhibiting a high, stable conductivity.

DIVERSEY NO. 12—for direct or reverse current electrocleaning of steel, copper and copper alloys.

DIVERSEY NO. 101—for direct or reverse current electrocleaning of brass.

DIVERSEY NO. 505—for direct or reverse current electrocleaning of zinc base die castings.

For demonstrations of any Diversey electrocleaner, or for free illustrated literature, write to: The Diversey Corporation, 1820 Roscoe, Chicago 13, Illinois, or Diversey Corporation (Canada) Ltd., Clarkson, Ontario.

DIVERSEY® **ELECTROCLEANING** ®

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LEA

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The softness of copper necessitates special methods and abrasives in finishing the surface. This metal is generally considered to flow readily during polishing and buffing operations and for this reason copper plate finds extensive application as an undercoat for nickel plate. Minor scratches and depressions in the base metal surface are filled with metal in this manner. General methods for the finishing of copper plate will be covered in a later Methods Sheet.

FLEXIBLE POLISHING... Removal of spinning marks, pits, small defects, etc., is usually done by flexible polishing with Grade "C" LEA COMPOUND on a loose muslin buff at about 6000 sfm.

SATIN FINISHING... This final finish is usually produced with Grade "C" or Grade "A" LEA COMPOUND on loose muslin buffs, ventilated or bias buffs, string or wick wheels. Buffs operating at 4500-6000 sfm will produce a fine satin finish on copper.

BRIGHT FINISHING... When a bright finish is required on solid copper articles made by casting or extrusion, the following procedure is typical:

1. Flexible polishing with Grade "C" LEA COMPOUND on a muslin buff with ⅜" spiral sewing at 5000 sfm.
2. Cut-down buffing with Grade 765 LEAROK or LIQUABRADE Grade TH62M, on a pocketed or ventilated buff at 7000 sfm.
3. Cut and color buffing with Grade 155 LEAROK or LIQUABRADE Grade UH20C on a full-disc, loose or pocketed buff at 7000 sfm.
4. Color buffing with Grade 309 LEAROK or LIQUABRADE Grade UH20A on a loose muslin buff at 6000 to 7000 sfm.

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How Versatile Application Techniques For Gold Solve Aircraft and Missile Problems

by WILLIAM L. AVES JR.

Since centuries before Biblical days, gold has been utilized practically altogether for its decorative and esteemable worth. Historical records state that gold was being mined in Egypt in the century 2,900 B. C., and that the art of gilding also dates back to pre-Biblical times.

Today industry is utilizing gold at an increasing rate in the aircraft, electronics, and nuclear fields. Relatively small parts not highly configured ,or containing deep narrow recesses or blind holes, are normally receptive to electroplated or vapor deposited gold coatings applied in a conventional manner in an economically sized tank or chamber. However, numerous aircraft and electronic components do not fall into this category. The scope of this paper will be devoted to a second category of large (one part is approximately twenty feet in length and five feet in diameter), highly configured, complex parts that are not economically suited for gold coating by electrolysis.

The technique for applying thin, adherent and continuous 24 carat gold plate to configured aircraft components by two, unique and versatile, methods are described. One method employs the principle of thermal decomposition of a gold resinate dissolved in an organic carrier, while the second method utilizes the more modern principle of ion displacement.

The applications for which gold coatings are required in modern day aricraft is summarized. Photographs of representative coated parts are shown. Future uses for unique application methods are discussed.

THE HIGHLY CONFIGURATED and stiffened internal area of the Scout Missile, Fig. 1, requires approximately 100 square feet of gold coated surface. To economically process the part, it was obvious that a more reliable and versatile method than electroplating or vapor deposition was required. It was for problems such as this that Chance Vought Aircraft, Inc., evaluated and incorporated an ancient method for applying gold to "space age" parts.

Application by Thermal Decomposition

Centuries ago gilded gold coatings were applied to base materials in a manner similar to the more recent "liquid gold" (German Glanzgold) process in use today. This process consists essentially of applying drying and decomposing to gold a gold resinate (i. e., sulpho-resinate of gold) dissolved in a suitable carrier oil (i. e., pine oil). Preparations consisting of proprietary modifications of this method, are available from commercial suppliers for applications.

Fig. 2 shows a typical Type 321 stainless steel section to which a low emissive 24 carat gold coating of approximately 0.00001 inch in thickness was applied internally after fabrication. After investigation of the other methods and processing techniques available for applying a low emissive, continuous gold coating to relatively large surfaces, the following procedure was adopted.

1. Preliminary cleaning was accomplished by vapor-spray-vapor degreasing.
2. Alkaline cleaning was performed anodically in a high quality commercial cleaning solution for 5 minutes at a concentration of 6-oz/gal and temperature of 180F.
3. Thorough rinsing was accomplished in a double rinse, the first rinse cold running water, and the second rinse hot water to facilitate drying.
4. Drying was obtained by use of forced hot air.
5. Parts were allowed to cool to room temperature.*
6. The gold coating was applied by spraying four cross coats of an organic solution composed of four parts of a commercially obtained liquid bright gold** and one part toluol by volume.
7. The coated parts were allowed to air dry 10 minutes.
8. Baking was then accomplished at 375F in air for 15 minutes.
9. The work was then thermally decomposed for 1 hour at 700F in air. The time at 700F will vary with the thickness of the coated panel.

Handling of the gold coated part requires extreme care if detrimental contamination and objectionable scratches and scrapes are to be avoided. The use of suitable wrapping for storage and transit and white cotton gloves by all handlers, including the subsequent fabricators, should aid in preventing excessive damage and contamination. Where possible, the use of a strippable organic coating will definitely benefit the handling of the part up to the time of necessary removal. For those applications where minimum emissivity or maximum heat reflectivity are not required in the lower temperature ranges (up to 600F), but essential at higher temperatures, protective organic coatings which will completely decompose to a gas around 600F, and not affect the gold, are presently under evaluation.

Fig. 3 is a photomicrograph showing a cross-section of a gold coating applied by this method to Type 321 stainless steel. The top coat of electrodeposited chromium was applied to prevent erosion of the gold during polishing of the mounted specimen.

To successfully apply 24-carat gold coatings by this method to low alloy and tool steels, aluminum, magnesium, copper and chromium base alloys, it is necessary to first apply a coating of electrolytic nickel or electroless nickel. The effects produced by the decomposing cycle on the metallurgical properties of

*Lead Engineer, Research and Development Unit, Engineering Structures Materials Group, Chance Vought Aircraft, Inc , Dallas, Texas

*Extreme care must be taken after this step to prevent soiling the surface with fingerprints, oil condensate, moisture, excessive dust or similar contaminates by use of suitable covering and handling equipment

**i e , Hanovia Chemical Co. Liquid Bright Gold No. 6854 or O. Hommel Co. Liquid Bright Gold No. 236.

the base material must be determined prior to use of this process. We have reduced the decomposing temperature to as low as 500F for an extended time period and obtained the desired high quality gold coating.

In the event of damage to the coating during or after fabrication into the final assembly, a versatile touch-up method is available as follows:

1. Solvent wipe the damaged area thoroughly by use of a clean cotton cloth saturated with toluol, xylol, or aliphatic naphtha. If tarnish stains remain, they may be removed by using a non-abrasive cleanser and a soft cotton cloth, followed by rinsing with a clean water saturated cloth, and dried with a clean absorbent lint free cloth or pad.
2. The liquid gold solution, previously described, is applied to the damaged area by use of a fine camel hair brush or artists air brush.
3. The touch up coatings were decomposed to pure gold coatings by use of infrared heat lamps in close proximity to the coated area. In those cases where the temperature of the coating during operation reaches that required for complete decomposition, and the time at temperature is adequate, cost savings and time savings can be realized by utilizing operative conditions for obtaining the desired coating. Where a low emissive gold coating is required from the beginning however, the preceding method calling for the utilization of operative conditions is unsuitable.

Immersion Gold Plating

Immersion gold plating is being used by Chance Vought Aircraft, Inc. for applying gold to printed electrical circuits and contacts made from copper. The non-conductive base panels to which the unetched copper circuits are bonded are generally composed of a laminated plastic material such as epoxy impregnated glass cloth, or phenolic resin impregnated paper.

Like all immersion processes, it is non-electrolytic and deposits the gold by ionic displacement. A perfectly clean precoated surface is essential to the quality of the gold deposited. After evaluations to determine the reliability and quality of the gold coating obtained on printed circuits, the technique adopted is as follows:

1. The printed circuit panels were thoroughly cleaned with an open cell sponge or absorbent pad saturated with a commercial non-abrasive cleansing powder solution.
2. Rinsing was accomplished by thoroughly wiping the part with a soft cloth in de-ionized running water.
3. The printed circuits are then immediately immersed for 5 minutes in a commercial immersion gold solution containing initially ½ troy oz of gold per gallon of solution. The temperature of the bath is maintained between 120 and 160F, and the *p*H is held between 7 and 8 by the addition of a small amount of ammonium hydroxide as the *p*H drops below 7. The inherent characteristics of the solution during extended operation cause the *p*H to drop slowly below 7, however, no difficulty has been experienced with control up to this time.
4. The work is then thoroughly rinsed in clean running deionized water.
5. The parts are then given a hot water rinse to facilitate forced air drying.

The 24 carat gold coating produced by this method on copper printed circuits is thin (approximately 0.000002 inch

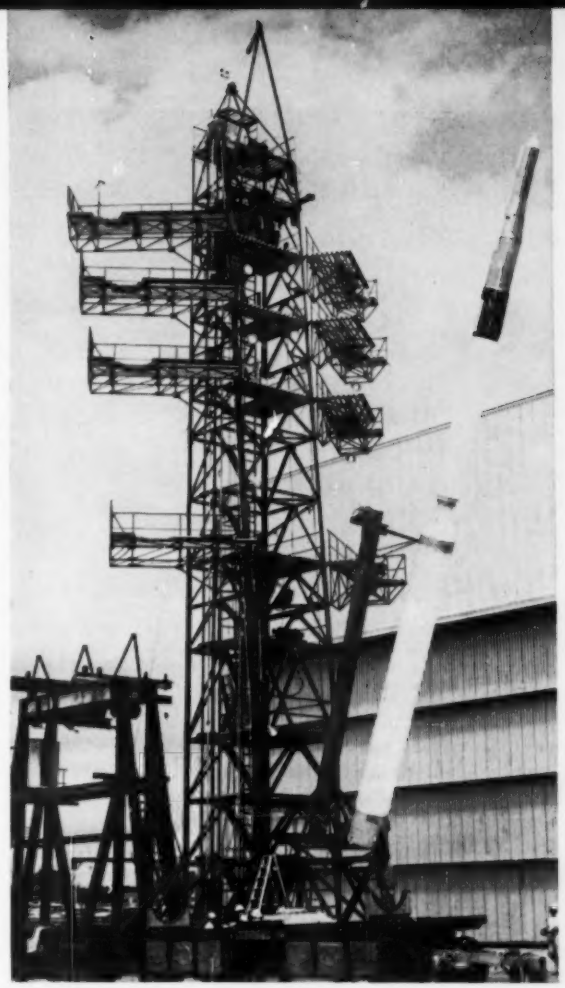

Fig. 1. First photograph release of a mock up of the Scout research rocket and launcher which are being fabricated and assembled at Chance Vought Aircraft, Inc. for the National Aeronautics and Space Administration. This four-stage solid propellant rocket can send a 100-lb instrument package 5000 miles or more in a high altitude shot, or place a 150-lb payload in a nominal 300-mile orbit around the earth.

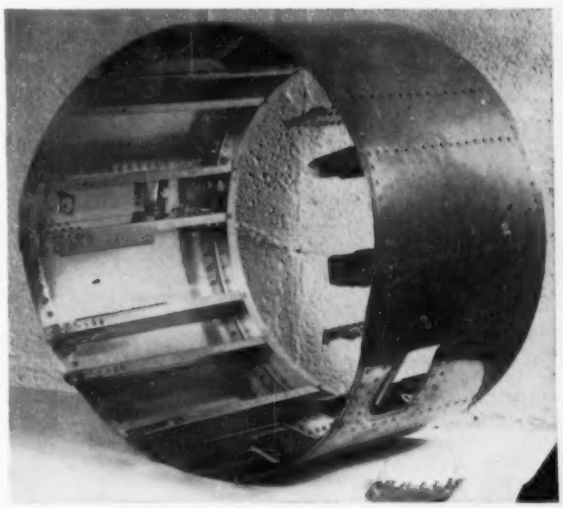

Fig. 2. Typical Type 321 stainless steel aircraft component to which a low emissive, continuous, highly reflective 24 carat gold coating has been applied by thermal decomposition.

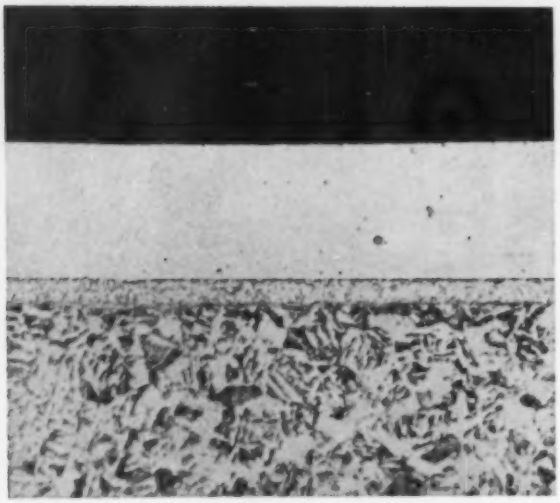

Fig. 3. Photomicrograph of a thermally decomposed gold coating (0.00002 in. thick) applied to Type 321 stainless steel base. The top coating of 0.0001 chromium plate was applied to protect the soft gold coating during polishing.

thick), continuous and economical. It is being utilized by Chance Vought Aircraft principally to extend the storage life of the printed circuits and improve solderability by increasing their resistance to oxidation and tarnish.RR

Immersion gold is presently being evaluated for use on nickel plated steel reflectors. A photomicrograph of an immersion gold deposit on a flash coat of electrolytic nickel deposited on H-11 tool steel may be seen in Fig. 4. A flash chromium plate was applied to the gold to prevent erosion during polishing. The immersion gold film barely discernible approximates 0.000002 inch in thickness.

Alternate Touch-Up Method

An electrolytic method worthy of being classified as a versatile method for applying a touch-up 24 carat gold coating is brush electroplating. Recessed areas, necessitating touch-up after installation, which are inaccessible to the use of heat lamps or resistance heaters, have been salvaged by the use of brush electroplating. Generally, long handled probe type brushes are required for use in the preceding application.

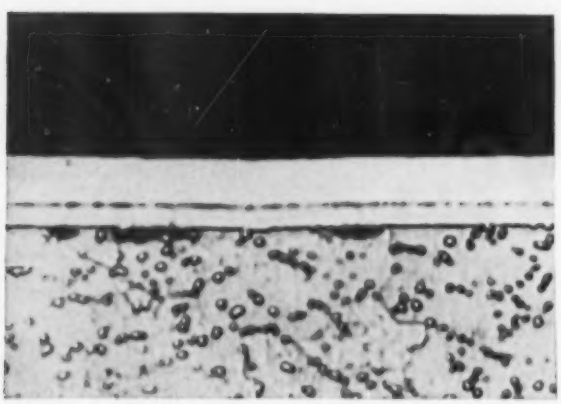

Fig. 4. Photomicrograph of an immersion gold coating applied to flash nickel plated H-11 tool steel. The top coating of chromium was applied to prevent erosion of the gold during polishing.

Uses

Before using gold coatings for aircraft parts, many factors must be considered. Such variables as maximum use temperature, gas environment, erosion, heat flux, time and base material will determine the success or failure of the application. For example, pure gold is a very soft metal and will not withstand even moderate erosive conditions. Firing it onto a pre-applied ceramic coating substantially increases its erosion resistance.

At elevated temperatures (1500–1900F) gold readily diffuses into steel, nickel, and many other metal substrates. This diffusion can be prevented by incorporating a diffusion barrier coating (i. e., N.B.S. A-418 ceramic coating) between the base and the gold. Conceivably, if the time at high temperature is short (2 minutes or less) or for one time use (i. e., non-recoverable missiles) the application of slightly thicker than normal gold coatings may be adequate for the part.

Fig. 5 shows stainless steel heat reflectors to which a gold coating has been applied and fired on. For temperatures up to 1950F, the ceramic coating prevents diffusion of the gold into the stainless steel base.

To better understand another application for gold or possibly other low emissive or highly reflective metals, we must consider modern day aircraft and weapon systems. Today's aircraft are large, hot bodies which radiate considerable infrared energy. The probability exists that an enemy's most efficient anti-aircraft weapons systems are those incorporating infrared seeking probes. For this reason, it is desirable to have the emissivity at all wave lengths as low as possible to reduce the possibility of detection. In other words, the absorption should be as low as possible and the reflectance as high as possible.

By preventing structural heating through the use of low emissive gold coatings on the internal skin structure or shroud, the heat radiated from the engine to the structure can be substantially reduced, thus lessening the danger of infrared detection by enemy weapon systems. A substantial reduction in costly shroud weight may also be realized by the incorporation of a gold coating in the above manner.

To understand the many space age applications for gold in aircraft, we will review some of its unique applications.

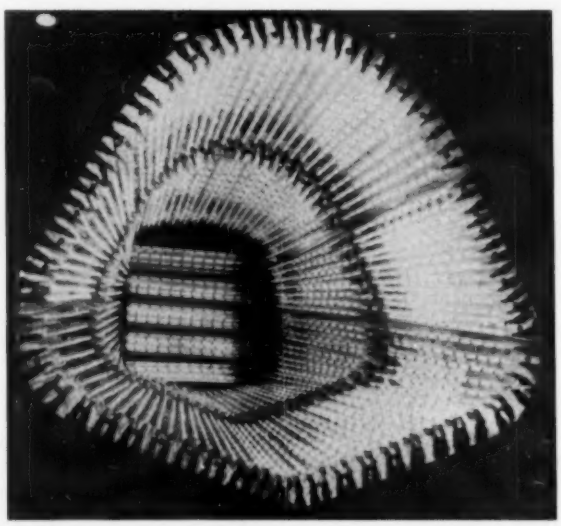

Fig. 5. Aerodynamic heating simulator unit, used for testing large configurated hypersonic leading edges up to 2000F.

Fig. 2 represents a section of the fourth stage of Scout missile. The problem in this case is to protect the payload within this stage with minimum weight from the excessive skin temperatures involved in traveling through the atmosphere at a high Mach number into space. To accomplish this, Chance Vought has incorporated (not shown in the figure) a highly emissive ceramic coating externally to radiate the friction heat back into the atmosphere, and, as shown, a low emissive gold coating internally to reduce heat radiation to the payload.

The highly configured boundary layer control system (Fig. 6) used to increase the performance efficiency of the F8U-3 Crusader used a low emissive thermally decomposed gold coating externally to substantially reduce radiation of heat from the hot system to the aileron and wing structure.

Fig. 7 shows some typical printed circuit boards which have had the copper circuits immersion gold plated. This method is considered to be by far the most economical for this application since the material costs amount to about 12 cents per square foot of copper coated or just a few cents for our average sized printed circuit board.

Elevated and high temperature problems coupled with structural and military requirements often require the use of tailor-made coating systems to provide an adequate solution. One such example is the multilayer coating system used on the first U. S. satellite. The magnesium base metal satellite utilized a protective laminated coating consisting of alternate layers of gold, chromium, aluminum, and silicon monoxide.

The use of thermally decomposed gold coatings is not ending in the coating field alone, but is entering the field of high temperature decomposable impregnants. Encouraging evaluation tests are being conducted on porous refractory structural materials and refractory metal coatings impregnated with gold. The missile era is imposing problems, requiring the use of gold, which were unimagined until very recently.

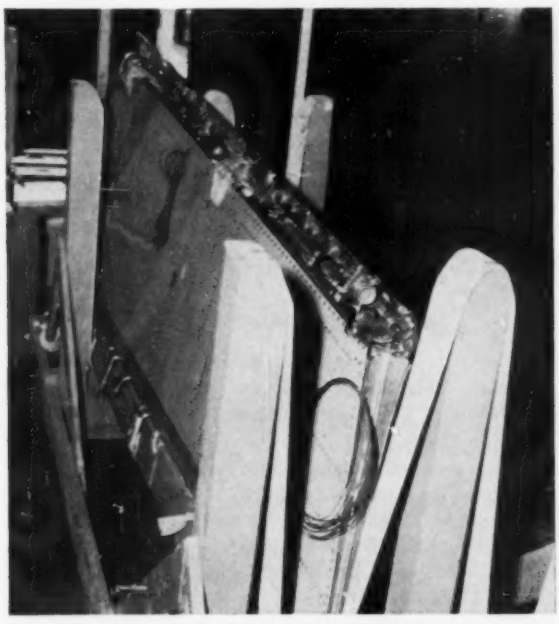

Fig. 6. Thermally decomposed gold coated boundary layer control tube installation on an aileron of the Chance Vought F8U-3 Crusader.

Fig. 7. Typical copper printed circuits which have been immersion gold coated.

Costs

For centuries gold has been associated with high costs, therefore, the first question the project or design engineers generally ask is, "How much will it cost?" Material costs amount to about six cents per millionth of an inch per square foot. Therefore, a normal coating of 0.00001 inch in thickness as applied by the thermal decomposition process will cost approximately 60 cents, and a normal coating of 0.0000021 inch thickness as applied to copper by the immersion process will cost approximately 12 cents per square foot. Since labor and basic material costs vary across the country, I will not attempt to itemize those costs. However, knowledge of such costs as labor, production, utilities, cleaning compounds, and required equipment will provide the reader with a close approximation of the costs to do the job.

Conclusion

In the past, gold was principally considered a material for use in the jewelry, monetary, and decorative fields. Today, gold is being utilized in an increasingly important and prominent position in the aero-space field.

Gold has been selected for space age prominence because of its inherent properties of low spectral emissivity, high heat reflectivity, high temperature oxidation resistance, relatively high melting point (1945F), and excellent corrosion resistance. The preceding properties when coupled with an economical, versatile and reliable method of application, makes gold increasingly desirable for use in this space age.

William L. Aves Jr. joined Chance Vought Aircraft, Inc., Dallas, Texas, in March 1956. His position is that of Lead Engineer in charge of the metallic and ceramic coatings section of the Engineering Structures Materials Department.

Mr. Aves majored in metallurgical engineering at Missouri School of Mines and Metallurgy, and is vice president of the Dallas-Fort Worth Branch of AES and a member of the Dallas-Fort Worth Branches of ASM and SAMPE.

FATIGUE STUDIES OF PLATED HOT WORK TOOL STEELS

by G. WILLIAM LAWLESS, VERNON F. LARDENOIT and BENNIE COHEN*

INTRODUCTION

THE NEED FOR ULTRA HIGH strength steels for use in aircraft at temperatures up to 1000F has caused an intensive study of the chromium hot work tool steels. These steels are not corrosion or oxidation resistant and require protective coatings both during and after exposure to elevated temperatures.

An extensive investigation of coatings for these steels by Metcut Research Associates, Cincinnati, Ohio[1] under Air Force Contract has shown that adequate oxidation and corrosion resistant coatings are available for use at long times up to 1000F. Their work also showed that the endurance limit of the high strength hot work tool steel used was drastically reduced by the coatings evaluated. This paper presents the fatigue evaluations made by Metcut Research Associates and the work accomplished by this Laboratory to alleviate the drastic drop in the endurance limit of coated tool steels.

CONTRACTORS FATIGUE EVALUATION

SPECIMEN PREPARATION

R. R. Moore rotating beam fatigue specimens were fabricated from the same heat of Thermold J alloy steel. This chromium hot work tool steel was obtained from Universal-Cyclops Steel Corporation as ¾ inch diameter bar stock and had the following chemical analysis:

C	Mn	Si	S	P	Cr	V	Mo	Ni
0.52	0.35	1.09	0.007	0.027	5.08	0.99	1.40	1.53

The bar stock was heat treated by austenitizing at 1800F for 20 minutes in a neutral atmosphere followed by cooling in this atmosphere to room temperature. The material was tempered in the neutral atmosphere at 1050F for two hours and cooled to room temperature in the same atmosphere. The tempering cycle was performed three times to stabilize mechanical properties. Grinding stock of 0.030 inch was removed after heat treatment. The hardness values of the steel ranged from 49 to 52 Rockwell "C." The specimens were finish ground after heat treatment except for the grip end, which were ground after the coatings were applied. A drawing of the fatigue specimen is shown in Fig. 1.

TENSILE TESTS

Tensile tests were performed on smooth specimens, heat treated as above, to determine the maximum temperature that the steel could be exposed to without seriously affecting its tensile strength. The average room temperature ultimate tensile strength of the Thermold J was found to be 258,000 psi. The ultimate tensile strength of the Thermold J when tested at 500F was 237,000 psi. Pre-exposing at 500F for 150 hours had no effect on the 500F physical properties. The ultimate tensile strength of the Thermold J when tested at 1000F was 171,000 psi. After pre-exposing for 150 hours at 1000F, the 1000F ultimate tensile strength of Thermold J dropped from 171,000 psi to 93,000 psi. This shows that the Thermold J tempered at 1050F is not stable for long periods at 1000F.

The room temperature tensile strength of the steel after pre-exposure for 150 hours at 900F was 249,000 psi. Since pre-exposing the steel at 900F just begins to temper the steel, it was decided to use this pre-exposure temperature for the fatigue specimens.

COATING APPLICATION

Six coatings were selected for evaluating their effect on the fatigue life of Thermold J since these coatings had shown varring degrees of capability to provide oxidation and corrosion resistance to the steel after exposure to 1000F. The coatings were all obtained from commercial vendors.

Electroless Nickel—Kanigen®—General American Transportation Corporation

1. Vapor degrease
2. Pickle in hydrochloric acid
3. Plate with 0.5 mil electroless nickel
4. Bake at 750F for one-half hour

Nickel—Zinc Alloy—Rockwell Spring and Axle Company

The nickel-zinc alloy was plated according to a patented process known as corronizing.

1. Vapor degrease
2. Anodically alkaline clean
3. Electro polish in phosphoric acid solution
4. Anodically alkaline clean
5. Pickle in dilute sulfuric acid
6. Nickel plate in a low *p*H Watts bath
7. Zinc plate in a zinc sulfate-chloride-acetate bath
8. Diffuse alloy at 700F

* Materials Laboratory, Wright Air Development Center, Wright Patterson Air Force Base, Ohio.

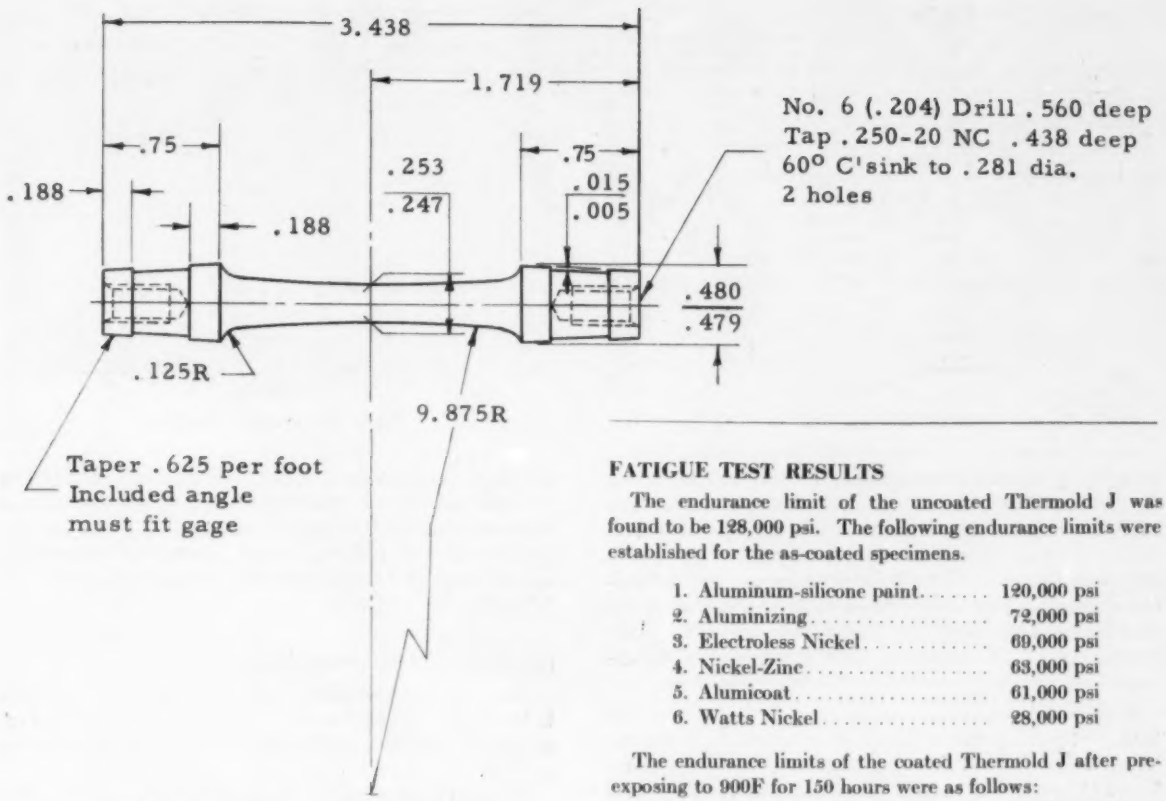

Fig. 1. R. R. Moore smooth fatigue specimen

Aluminizing S 10-99—Solar Aircraft Company

1. Degrease
2. Light sandblast
3. Spray on coating
4. Dry in hot air
5. Fire at 1300F for 10 minutes

Alumicoat—Arthur Tickle Engineering Works, Inc.

1. Degrease
2. Preheat and flux in salt at 1325F for one minute
3. Dip in molten aluminum at 1325F for 30 seconds
4. Remove excess aluminum in salt layer for 30 seconds
5. Air cool and wash

Watts Nickel Plate—Smith Electrochemical Co.

1. Vapor degrease
2. Pickle in hydrochloric acid
3. Plate to 1.5 mils in a low *p*H Watts solution containing only an anti-pitting agent.
4. Bake at 375F for three hours

Aluminum Silicone Paint—Tropical Paint Company

1. Degrease in cellosolve
2. Zirconite blast
3. Spray on paint
4. Air dry for one hour
5. Cure at 400F for one hour

FATIGUE TEST RESULTS

The endurance limit of the uncoated Thermold J was found to be 128,000 psi. The following endurance limits were established for the as-coated specimens.

1. Aluminum-silicone paint	120,000 psi
2. Aluminizing	72,000 psi
3. Electroless Nickel	69,000 psi
4. Nickel-Zinc	63,000 psi
5. Alumicoat	61,000 psi
6. Watts Nickel	28,000 psi

The endurance limits of the coated Thermold J after pre-exposing to 900F for 150 hours were as follows:

1. Aluminum-silicone paint	120,000 psi
2. Electroless nickel	64,000 psi
3. Alumicoat	63,000 psi
4. Aluminizing	55,000 psi
5. Nickel-zinc	52,000 psi
6. Watts nickel	34,000 psi

S-N Curves are shown in Figs. 2 and 3.

EXPERIMENTAL

The unexpected drastic drop in the endurance limit of the steel resulting from plating prompted this Center to attempt to find methods of alleviating this condition. The lowering in the endurance limit could not be explained by the fact that a highly tensile stressed coating will lower the endurance limit, since the soft watts nickel had a more drastic effect than the

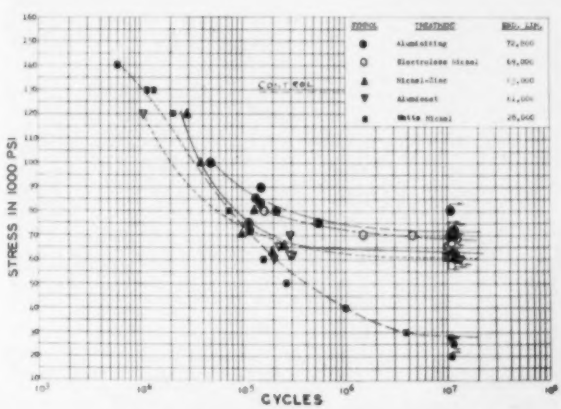

Fig. 2. As coated specimens. (Ref. 1)

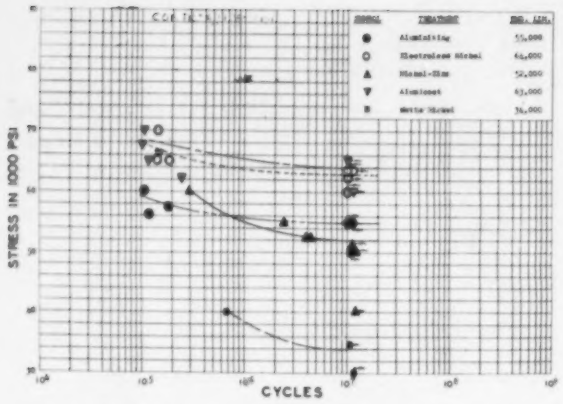

Fig. 3. Coated specimens, baked at 900F for 150 hr. (Ref. 1)

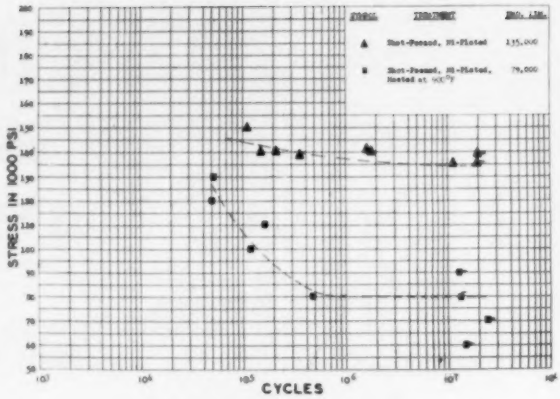

Fig. 5. Shot-peened specimens

hard highly stressed electroless nickel. The lowering of endurance limit could not be explained as a temperature-time effect since the as-plated fatigue specimens were also drastically effected. It was therefore assumed that the drastic drop was due to some interfacial effect caused by the bonding obtained in plated or sprayed metal coatings, since the aluminum silicone paint coating had no appreciable detrimental effect. The endurance limit of the steel tested appears to be extremely sensitive to this interfacial effect.

Prior experience by various investigators has shown that both shot-peening and nitriding are beneficial in increasing the endurance limit of chromium plated steels. Shot-peening leaves the surface in residual compression by means of cold working. Nitriding leaves the surface in residual compression by nitride precipitation, in the surface layer, accompanied by a volume expansion.

The high strength steel could be nitrided without appreciable effecting its mechanical properties since it had been tempered at 1050F. Nitriding is usually performed at a minimum temperature of 975F. The questions that had to be answered were whether a compressive stressed surface would alleviate the lowering in endurance limit, and whether a 900F long time soak would stress relieve the cold worked surface resulting from shot peening to a degree that no beneficial effect was obtained.

NITRIDING AND SHOT PEENING

The fatigue specimens used were identical in every aspect to those used in the prior study. One group was nitrided by heating in a nitriding gas for 30 hours at 1000F and 15 hours at 975F.

Another group of fatigue specimens was shot-peened using 0.035 inch diameter cut wire shot with an air pressure of 45 psi. The specimens were mounted vertically and rotated at 84 rpm. A two inch vertical nozzle stroke was used, with the distance from nozzle to specimen maintained at six inches. The time of peening for each specimen was six minutes. Almen strips when peened while stationary for 90 seconds produced an arc height of 0.014 inches.

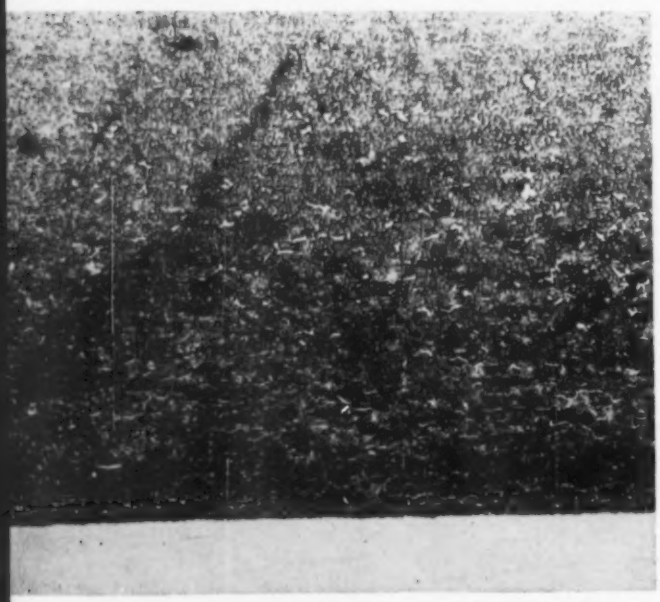

Fig. 4. Nickel plated nitrided Thermold J Steel. Effective case—2 mils. 500X

PLATING

Since the nickel plating had the most drastic effect in lowering the endurance limit of the tool steel, it was also used on the shot peened, and nitrided specimens.

A conventional plating procedure was not satisfactory in obtaining adequate adhesion on the nitrided steel. The following procedure was used with excellent results:

1. Solvent clean
2. Anodically alkaline clean
3. Anodically etch in H_2SO_4 (20 per cent Vol.)—H_3PO_4 (80 per cent Vol.) at 200 asf for 10 minutes at room temperature
4. Anodically alkaline clean
5. Dip in HCl for 30 seconds
6. Nickel Plate (1 Mil) in basic Watts nickel bath containing only an anti-pitting agent.

The shot-peened specimens were also nickel plated using the above procedure. One group of nitrided specimens was plated with a nickel-zinc alloy by plating 0.8 mil of nickel and 0.4 mil of zinc, and diffusion alloyed by heating at 700F for one hour. The specimens not subjected to the 900F temperature exposure were baked at 375F for three hours after plating. A photomicrograph of the nickel plated nitrided steels is shown in Fig. 4.

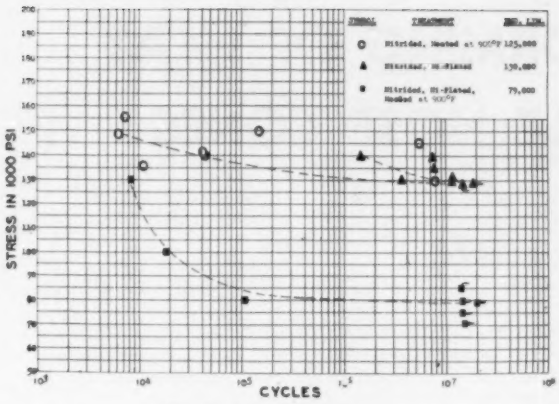

Fig. 6. Nitrided specimens

FATIGUE TEST RESULTS

Excessive scatter in the results of the fatigue tests does not permit the establishment of accurate endurance limits for the various treatments given the steel. The values given indicate the approximate endurance limits only for purposes of comparison.

1. Bare steel (Control) ..... 128,000 psi
2. Shot-peened, nickel, plated ..... 135,000 psi
3. Shot-peened, nickel plated, baked at 900F for 150 hours ..... 75,000 psi
4. Nitrided steel, control, baked at 900F for 100 hours ..... 120,000 psi
5. Nitrided steel, nickel plated ..... 128,000 psi
6. Nitrided steel, nickel plated, baked at 900F for 100 hours ..... 79,000 psi
7. Nitrided steel, Ni-Zn alloy, baked at 900F for 100 hours ..... 75,000 psi

S-N Curves are shown in Figs. 5 and 6.

DISCUSSION AND CONCLUSIONS

Shot-peening and nitriding prior to nickel plating raised the endurance limit of the plated steel from 28,000 psi to 135,000 psi and 128,000 psi respectively. More importantly shot-peening and nitriding prior to nickel plating raised the endurance limit of the plated steel from 34,000 psi to 75,000 psi and 79,000 psi respectively after being exposed to 900F for a total of 150 hours. The exposure time for the nitrided specimens includes the time used during the nitriding process.

The shot-peened nickel plated specimens had a reduction in endurance limit from 135,000 psi to 75,000 psi after baking at 900F for 150 hours. This can probably be explained by a time-temperature stress relieving effect on the cold worked surface.

No good explanation can be given as to why the endurance limit of the nitrided steel, 120,000 psi, was reduced by nickel plating and nickel-zinc alloy plating to 79,000 psi and 75,000 psi respectively, since all were subjected to the same time-temperature exposure. This is again probably due to some unknown interfacial effect between the plated coating and the nitrided surface.

Shot-peening would be preferred for most applications over nitriding since the hard surface layer of a case-core structure is usually brittle, and more sensitive to notches than the unaltered core. If the tensile stress at a notch does become great enough to initiate cracking, then the crack could spread rapidly through the case and core.

In summary, the significant conclusions that can be reached as a result of the work performed are:

1. The endurance limit of the chromium hot work tool steel investigated was drastically lowered by plated, sprayed, or dipped metallic coatings in both the as coated condition and after exposure to elevated temperatures.

2. Both shot-peening and nitriding the steel prior to coating restores the endurance limit of the steel in the as coated condition.

3. Both shot-peening and nitriding significantly improves the endurance limit of the steel after exposure to elevated temperatures.

4. Aluminum silicone paint does not significantly lower the endurance limit of the steel.

ACKNOWLEDGMENT

The authors would like to acknowledge the assistance of Aeroproducts, Allison Division, General Motors Corporation, whose personnel performed the shot-peening for this investigation.

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COPPER ELECTROFORMING OF HEAT SINKS FOR MISSILE NOSE CONES

by FRANK D. FOLEY*

The electroforming of copper-stainless steel heat sinks by Avco-RAD for the Titan nose cone is discussed. The difficulties associated with electroforming very thick deposits of copper on a very large dish-shaped stainless steel shell are reviewed. The chemical and physical properties of the electrodeposit are measured and compared to standards (OFHC and Specification).

INTRODUCTION

In connection with the development of the Titan missile for the U. S. Air Force, a method was required for fabricating very large copper-stainless steel structures, which are capable of withstanding the high heat-inputs associated with re-entry temperatures. Avco RAD was given the responsibility for developing a suitable method of fabrication.†

The electroforming of copper was one of several processes proposed for fabricating copper bonded to stainless steel heat sinks. Included among the other methods were the following:

(a) Vacuum casting, (b) Brazing, (c) Hot pressure-bonding, (d) Overlay welding, (e) Hydroforming of preclad shapes.

The copper-electroforming process was chosen because:

(a) Electroforming produced dense, pure copper deposits of a quality sufficient to meet the needs of the program.
(b) Electroforming requires no special dies, presses, excessively large castings, or heavy plates.
(c) A minimum of machining was required to obtain desired contours.
(d) Electroforming was more adaptable to in-process quality control procedures.
(e) Defective increments of an electroformed deposit could be easily removed by deplating or acid stripping.

Experimental studies on the copper electroforming process were performed at Avco RAD. Production electroforming of the heat-sinks was accomplished under subcontract at the Bone Engineering Corporation, Glendale, California.

A. BASIS METAL AND ITS PREPARATION FOR ELECTROFORMING

1. Method of Fabrication

The structural backup shell designed by Avco RAD for the nose cone heat-sink was a stainless steel dish (Type 316, ASTM-A240 Grade M). Type 316 stainless steel was selected as the shell material because of its high-temperature properties, availability, ease of fabrication, and satisfactory welding properties.

Experimental units were first fabricated by spinning. When the required shell thickness exceeded the spinning capacity, the shells were then fabricated by a hot-pressing operation.

Before acceptance for production, samples from the blanks were macroetched, mechanically tested, chemically analyzed, and tested for microstructure. The tests included the electrolytic oxalic acid-etching test described in ASTM Specification No. A-262-59T. The billet itself was inspected both radiographically and ultrasonically.

After pressing the shell, a thieving skirt, seamless-forged and rolled to shape, was welded vertically to the periphery of the shell. This, in effect, increased the depth of the shell, provided a plating "thief" or robber, and allowed for attachment of test plates (these are described in detail later).

The composite shell and skirt was then rough-machined internally and externally to specified contours, and stress-relief-annealed.

The inner contour was then machined to finish contour,

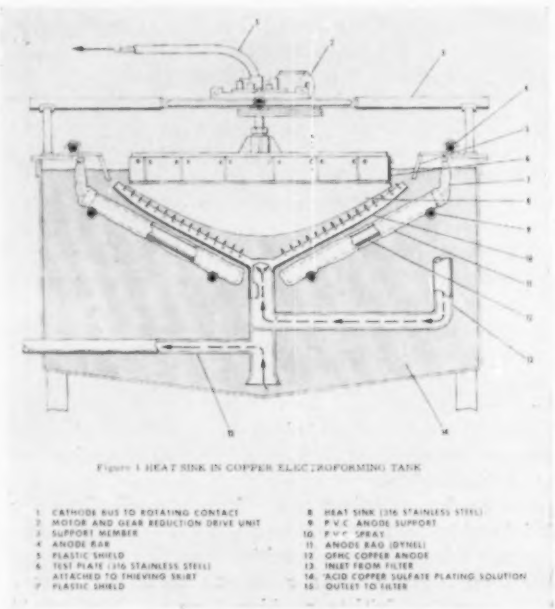

Figure 1 HEAT SINK IN COPPER ELECTROFORMING TANK

1. CATHODE BUS TO ROTATING CONTACT
2. MOTOR AND GEAR REDUCTION DRIVE UNIT
3. SUPPORT MEMBER
4. ANODE BAR
5. PLASTIC SHIELD
6. TEST PLATE (316 STAINLESS STEEL) ATTACHED TO THIEVING SKIRT
7. PLASTIC SHIELD
8. HEAT SINK (316 STAINLESS STEEL)
9. P.V.C. ANODE SUPPORT
10. P.V.C. SPRAY
11. ANODE BAG (DYNEL)
12. OFHC COPPER ANODE
13. INLET FROM FILTER
14. ACID COPPER SULFATE PLATING SOLUTION
15. OUTLET TO FILTER

Fig. 1. Heat-sink in copper-electroforming tank.

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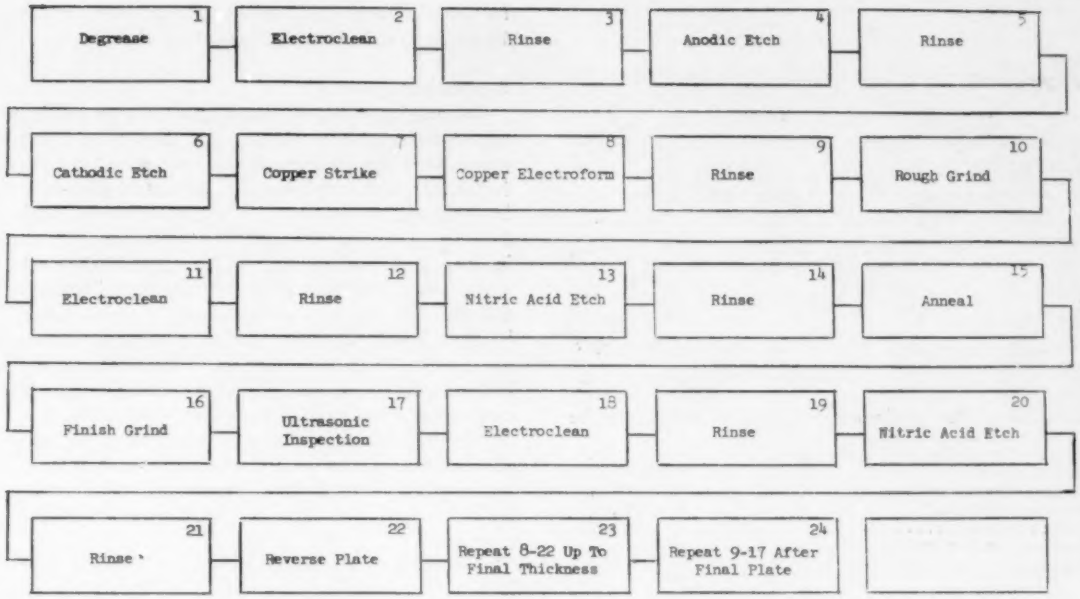


Fig. 2. Flow chart for copper-electroforming process.

and studs and flanges required for subsequent attachments were welded in place. The shell was then stress-relieved.

2. Surface Preparation for Electroforming

The outer surface of the shell and skirt was finish-ground and polished to a surface finish of 15 to 25 μ in. rms and inspected by means of a profilometer. The surface was then vapor-honed to a nondirectional finish, with maintenance of the same 15 to 25 μ in. rms surface, and again inspected.

Hothersall,[1] Mesle,[2] and many others have found that the smoother the surface of the basis metal, the better the bond to the electrodeposited metal. This was confirmed by our tests. Tensile bond-strengths were in most cases equal to or greater than the tensile strength of the weaker metal. The results are discussed in greater detail in a later section.

3. Attachment of Test Plates

Test plates, 5-in. by 10-in. by 0.125-in., with beveled front surface edges, were attached (see Fig. 1) to the thieving skirt. The edges were beveled to minimize solution turbulence and to prevent non-plating of adjacent areas.

The test plates, which were processed in precisely the same manner as the heat-sink shell (i.e., fabrication, annealing, and surface finishing) were used to provide a continuous check of the electroforming process.

All weld fillets on which it was necessary to deposit copper were at this time passivated with nitric acid solution, to prevent possible preferential attack because of differences in potential when subjected to the subsequent electrolytic etching treatment.

B. ELECTROFORMING PROCESS

1. Solutions Used

The stainless steel shell was attached to a fixture which served to hold and rotate it and provided electrical contact (Fig. 1). The shell was first degreased, then electrocleaned in a hot alkaline solution. The part, during electrocleaning and all subsequent electrolytic or etching processes, was rotated in a horizontal plane at 21 rpm. Cleaning was followed by anodic and cathodic treatment in sulfuric acid solutions (420 amp min/ft^2, and 300 amp min/ft^2, respectively). Cold-water rinses were used after the electrocleaning and anodic-etching steps.

The most critical step in achieving a high-strength bond depends on very rapid transfer from the cathodic etch to the copper sulfate sulfuric acid strike solution which followed. The hydrogen film, which is deposited on the stainless steel surface during cathodic treatment in sulfuric acid, cannot be allowed to dissipate before deposition of the copper strike. The rate of dissipation is a function of time, temperature, and humidity of the atmosphere. For these reasons, transfer must be accomplished in less than 35 sec, no mean task when the size of the heat sink is considered. There was no rinse between the cathodic treatment and the copper strike.

Electrical contact was made before immersion of the shell into the copper-strike solution to prevent premature dissolution of the hydrogen film.

Filtered copper-strike solution was sprayed through a six-legged submerged spray system (Fig. 1), in series with the pump and filter. The legs of the polyvinyl chloride (PVC) spray system conformed to the contour of the convex surface of the shell. Fresh solution was carried through them to the face of the part at a rate of 3000 gal/hr. The solution was made up with demineralized water, and was filtered through carbon and filter-aid. Conforming anodes (OFHC copper) were bagged in Dynel.

After deposition of approximately 0.1 mil of copper upon the surface of the shell, it was transferred, without rinsing, with current on, to the copper electroforming tank. A rapid visual inspection of the surface was made, while the shell was being transferred, to determine the uniformity of the appearance of the deposit and to detect any unplated areas.

After the shell was completely immersed in the copper electroforming solution, the current was adjusted to 20 asf and plated for a period of 30 min, after which the current density was increased to normal operating value.

Operating conditions in the copper-electroforming solution are summarized as follows:

739 Original Magnification—Horizontal 150X Vertical 840X

Fig. 3. Taper section of electroformed copper, nickel-plated for edge preservation.

Depth of severely deformed surface layer	0.00007 in.
Average depth of cold work	0.00007 in.
Maximum scratch depth	0.00009 in.
Maximum scratch width	0.002 in.
Surface roughness	26 μ in. rms
Imbedded abrasive particles	None
Grinding sequence for copper	Nos. 36, 80, 150, 240 Al_2O_3 Abrasive

(a) Solution: $CuSO_4 \cdot 5H_2O$ (CP grade) 28–32 oz/gal
H_2SO_4 (CP grade) 10–12 oz/gal
Demineralized water

(b) Anodes: OFHC copper.

(c) Anode Area: The effective anode area was at least equal to the area of the surface to be plated.

(d) Agitation: Cathode rotation, 21 rpm.

(e) Filtration: Continuous filtration through carbon (Darco S-51) and filter aid (Solka Floc BW-40). Filtered solution impinges on the surface of the shell at a rate of approximately 12,000 gal/hr.

(f) Temperature: 110 ± 2F.

(g) Time: As required to produce desired thickness.

(h) Periodic Reverse Cycle: 50 to 70 per cent cycle efficiency.

(i) Tank Material: Hot-rolled steel lined with PVC.

(j) Anode Bags: Dynel.

(k) Current Density: As defined by the following:

Holding min 40 asf	Current Density	2.2 mil/hr	Plating Rate (Approx)
Average min 54 asf			
Max local No burning		3.0 mil/hr	

No addition agents were used, because under atmosphere re-entry heating conditions the occluded organic material would cause rupture at the surface, with subsequent aerodynamic instability and thermodynamic failure.

The anode to cathode ratio was kept high to achieve maximum rates of deposition and prevent anode polarization difficulties.

Rotational speeds were kept below 25 rpm because laboratory tests indicated that the rate of solution flow against the surface of the shell was a more important variable than the rate of rotation of the part. Practical considerations led to a choice of low rotational speeds. High speeds cause excessive turbulence (the peripheral speed of the shell is 330 ft/min at 21 rpm) and make necessary additional tank supports and safety measures.

The electroforming process was an around-the-clock, 7-day-per-week operation. The process, although continuous, when unattended necessitated using lower-current densities to allow continued electrodeposition over a weekend. This accounts for the wide range in allowable periodic reverse cycles (50 to 70 per cent) and current densities tabulated above.

2. Process Cycle

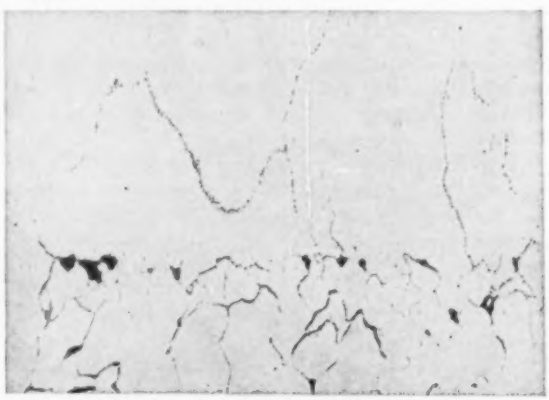
The first increment of electrodeposited copper (Fig. 2) was approximately 1/8-in. thick. The shell, after being withdrawn from the plating solution, was rinsed, rough-ground (with Al_2O_3 abrasives from Nos. 36 and 80 grit) and etched in 50 per cent by volume nitric acid to remove approximately 0.003 in. of copper. The shell was then stress-relief annealed in dry, deoxidized nitrogen. The copper surface was then ground, with water as a lubricant, with Al_2O_3 abrasives (Nos. 150 and 240 grit) to a surface finish of approximately 35 μ in. rms. Missel,[3] in plating on copper for missile applications, also reported the need for superior surface finishes in obtaining better bonds. Laboratory experiments which preceded the choice of grinding sequences are illustrated in Fig. 3.

Physical tests, to evaluate the strength of the copper-to-stainless steel bond, were performed on the test plates. Ultrasonic testing of both test plates and heat sink followed. Both testing procedures are discussed in detail under quality control procedures.

Subsequent to successful conformance to specifications, the heat sink was electrocleaned, etched in nitric acid solution to remove approximately 0.002-in. of copper, and returned to the electroforming solution. The shell was briefly deplated (not to exceed 30 sec) before resumption of electroforming. Difficulties encountered as a result of excessive nitric acid etching and deplating, associated with current interruptions, are depicted in Figs. 4 and 5.

It is believed that excessive nitric acid etching, with preferential intergranular attack, will cause expansion into grain boundary voids when heated. The extension of deplating time in starting a new electroforming cycle serves to concentrate impurities along the grain boundaries when plating is resumed. These inclusions then expand along grain boundaries when heated.

The voids or inclusions present in Figs. 4 and 5 have little effect on the strength characteristics of the copper before heating. Experiments performed with a hot-stage microscope showed that the expansion or penetration of the material into surrounding areas or grain boundaries occurred at approximately 950F. The penetration occurred along the grain boundaries of the new equiaxed grains formed in the process of heating.



1041 NH_4OH-H_2O_2 Original Magnification 150X

Fig. 4. Grain-boundary penetration at current-interruption zone on electroformed copper, caused by excessive etching (25 min in 50 per cent volume HNO_3). Sample treated at 1200F for 3 hr in nitrogen atmosphere.

1055 NH_4OH-H_2O_2 150×

Fig. 5. Current-interruption zone in sample of electroformed copper. Sample was made anodic for 15 min before start of replating. Impurities probably removed in deplating phase and redeposited in plating phase.

Brief inspection of the electroformed surface was performed daily to evaluate the progress of the process. The surface was not allowed to dry during inspection.

Contoured deposition was accomplished by insertion of PVC shields between the anodes and the heat sink, or by capping the anodes.

The second and subsequent increments, applied to achieve full thickness, were of the order of 0.25-in. thick. Approximately 800,000 ampere hours were required to deposit the specified thickness, plus 0.25-in. for machining. Thickness measurements, prior to completion of the process, were made by template and by ultrasonic techniques.

C. QUALITY CONTROL PROCEDURES

To fabricate a structure capable of successfully re-entering the earth's atmosphere at the speeds contemplated, and to satisfy the specifications established by Design, Aerodynamics, Applied Mechanics, and Materials scientists, requires exacting quality control.

1. Test Plates

Test plates (Fig. 1) were used to establish the chemical composition and physical properties of the heat-sink copper. The correlation of physical properties and resultant reliability is tabulated in Table I.

TABLE I
COMPARISON OF VARIOUS PHYSICAL PROPERTIES OF HEAT-SINK AND TEST-PLATE COPPER

Property	Heat Sink	Test Plate
Bond Shear Strength (psi)	21,695	21,570
Tensile Bond Strength (psi)	35,400	37,733
Tensile Strength (psi)	31,825	31,950
Yield Strength, 0.2% offset (psi)	12,475	14,500
Density (g/cc)	8.9412	8.9398

Table II reveals the close similarity which exists between the chemical composition of test-plate and heat-sink copper, and both are compared with specification requirements.

The widest variation in chemical composition occurred in the amount of oxygen found in test-plate copper as compared with that in heat-sink copper. The reason is probably that the test plates, attached to the thieving skirt, were positioned closer to the solution surface where turbulence of rotation and the small variations in solution level cause an increase in absorbed oxygen concentrations of the solution. Since the oxygen content of the test plate copper was, in all instances, higher than that of the heat-sink copper, the analysis still served as a correlative tool.

TABLE II
COMPARISON OF CHEMICAL PROPERTIES: SPECIFICATION, HEAT-SINK, AND TEST-PLATE COPPER

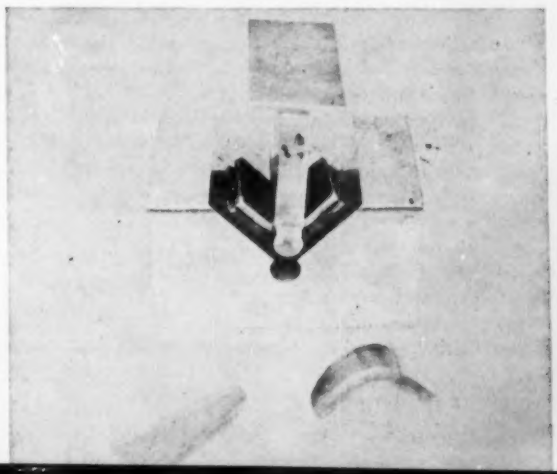
Per Cent	Specification	Heat Sink	Test Plate
Cu purity	99.92 Min	99.95–99.99	99.95–99.99
H_2	0.0005 Max	<0.0001	0.0001–0.0003
O_2	0.0008 Max	0.0002–0.0008	0.0007–0.0018
N_2	0.0001 Max	<0.0001–0.0001	<0.0001–0.0001
P	0.0005 Max	ND*	ND
S	0.004 Max	ND	ND
Bi	0.0001 Max	ND	ND
Sb	0.0005 Max	ND	ND
As	0.0003 Max	<0.0001	0.0001
Ni	0.001 Max	<0.0001	0.0001
Fe	0.001 Max	ND	0.0003
Ag	0.010 Max	0.0002–0.0003	0.0005
Se + Te	0.001 Max	ND	ND
Si	0.001 Max	0.0001–0.0005	0.0002

*Element was sought but not detected; others not detected were: Mn, Co, Sn, Pb, and Cr; other elements detected were: Cd— <0.0001 and C— <0.005 per cent.

Metallographic examination of test-plate copper also served to evaluate the general structure of heat-sink copper. The columnar grain structure of the heat-sink copper was reproduced on test plates. A laminar-type defect, coincident with a current-interruption zone, was discovered by metallographic examination of a test plate. The same defect was found to be present on the heat sink when it was sectioned. It must be realized, however, that, while this correlation did exist with a general condition as described above, a minute specific-area defect in the heat sink would not be detected in the test plates.

Laminar-type defects can be detected by physical testing of the test plate. In the test, a portion of the test plate, ¼ by 2 in. by thickness of deposit plus the stainless steel basis metal, is heated in N_2 and allowed to cool, and then bent around a ½-in. radius pin 90 degrees to the direction of grain growth. Bending puts the several interfaces (bonds of

Fig. 6. Fixture for transverse bend-test and bend-test specimens.



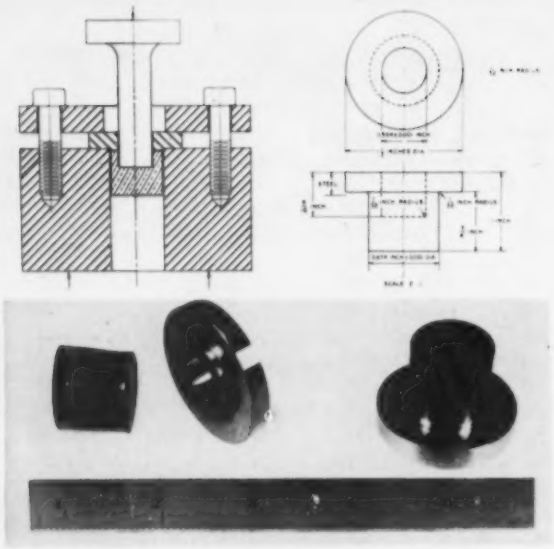


Fig. 7. Tensile strength of bond between copper and stainless steel. (Upper left) Cross-section of specimen and holder. (Upper right) Dimensions of specimen for tensile bond-test. (Bottom) Specimens for tensile bond-test.

copper-to-copper and copper-to-stainless steel) in biaxial tension and causes separation at defective interfaces. When poor adhesion was found, the heat sink was deplated to remove the non-adherent layer, after which electroforming was resumed.

Other physical tests of the test plates included tensile bond, bond shear, notched bend, unnotched bend, and tensile strength of copper at room and elevated temperatures.

2. Ultrasonic Testing

The ultrasonic method, rather than radiography, was best suited to the problem of determining soundness and thickness of copper and stainless steel heat sinks. Radiography proved valuable as an aid in the interpretation of earlier ultrasonic test results during the test-method development program.

Ultrasonic detection and measurement of discontinuities were performed while the heat sink was rotated in a tank of water, with the convex surface uppermost. Optimum results dictated the use of a 10 megacycle per second test frequency, using a medium focal-length lithium sulfate transducer with a working distance (water-path length) of from 3.0 to 4.0 in. The test plates were also ultrasonically inspected.

3. Process Control Equipment and Precautions

Stringent controls and precautions were required to eliminate as many processing variables as possible, consistent with obtaining best results, to establish correlation between electroforming results and process variations, and to guide subsequent studies and recommendations.

The equipment and precautions listed below, except as noted, were used in conjunction with the copper-plating solution. Although not necessarily used in standard plating practice, they are fairly well-known and will be described only as required.

(a) Ampere-hour meter.
(b) Heat exchanger.
(c) Temperature recorder.
(d) Ampere recorder.
(e) Plating log and daily inspection checkoff list.
(f) Bagged anodes.
(g) Scheduled carbon treatment.
(h) Anodes added only when shell is out of bath.
(i) Minimum of 2 hr filtration before processing of shell.
(j) Continuous filtration through carbon and filter aid during processing.
(k) Electrolytic purification in a separate tank in series with the electroforming solution, before filtration. The solution was fed to the dummy tank by means of overflow sumps. This action also served to keep the solution surface clean. The current capacity of the purification system was 0.05 amp/gal of copper sulfate solution with a current density of 5 amp/ft². Spectrographic data accumulated to date show that filtration and electrolytic purification maintained the metallic impurity concentration of the solution below the level at which the metals could be codeposited in quantities sufficient to exceed specifications.
(l) Use of demineralized water in final rinses and in the makeup and replenishment of etches, strike, and plating solutions.
(m) All tanks covered when not in use and the electroforming tank covered while in actual use.
(n) All grinding performed in a well-vented area separated from the plating line.
(o) Clean, filtered air, drawn into the plating room and vented by blowers, to minimize the harmful effects of airborne dust, grinding particles, etc.
(p) Chemical analysis of the plating solution before entry of the heat sink for any increment.
(q) Periodic spectrographic analysis of the plating solution to monitor build up of metallic impurities.
(r) Use of test plates as described previously.

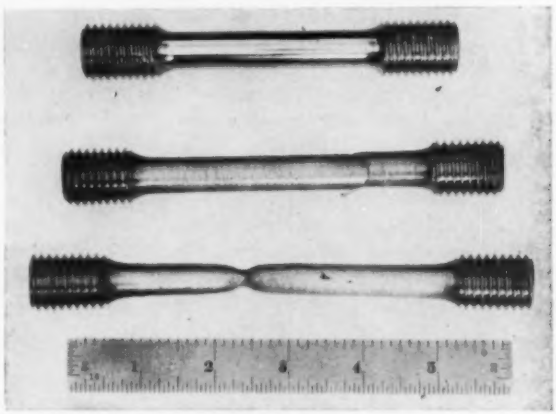


Fig. 8. Tensile strength of electroformed copper.

Top:	Specimen for tensile test of copper	
Center:	Copper specimen	Axis of specimen is normal to grain growth
	Heat-treated for 1 hr at 700F in N_2	
	Test temperature	Room
	Tensile strength	31,900 psi
	Yield strength	12,300 psi
	Elongation	38.5%
	Reduction in area	35.0%
Bottom:	Copper specimen	Axis of specimen is normal to grain growth
	Heat-treated for 3 hr at 1200F in N_2	
	Test temperature	Room
	Tensile strength	28,900 psi
	Yield strength	5,900 psi
	Elongation	63.0%
	Reduction in area	80.0%

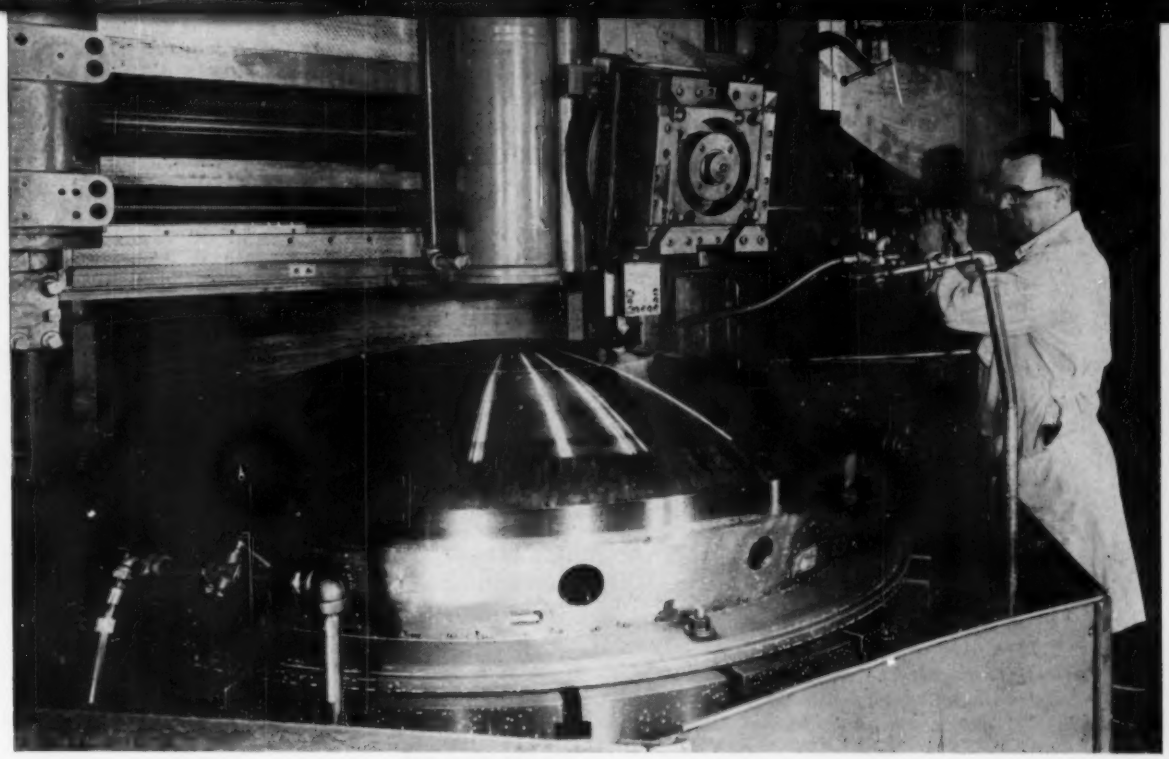


Fig. 9. Machining of electroformed copper.

D. TESTING OF THE FINISHED PRODUCT

A number of heat sinks, electroformed to full copper thickness, have been sectioned, (a) to study the effects of various process improvements, (b) to establish the reliability of nondestructive inspection techniques, and (c) to correlate test-plate and heat-sink properties, both chemical and physical. Much of the test data are classified, for security reasons, and, therefore, can be treated only in very broad terms.

1. Nondestructive Test

(a) Radiographic inspection

The first heat sinks produced by copper electroforming were radiographed upon completion. The equipment used was a Norelco 300 KVCP X-ray unit with a 5 mm focal spot. The heat sink was mounted on a wooden form and radiographed with the film against the steel shell. Sensitivity was determined to be of the order of one per cent.

Radiography was discontinued because the maximum size of allowable defect in the heat-sink copper was smaller than could be detected by radiographic techniques. Furthermore, radiography did not disclose laminar-type defects.

(b) Ultrasonic inspection

Inspection of completed heat sinks was performed with a Curtiss-Wright Model 424A Immerscope at frequencies of 5.0 and 10.0 mc/sec. Techniques developed at Avco RAD have increased capabilities to the extent that defects in the copper as small as 1/32-in. (0.031) in diameter can be detected, and flaws as small as 1/16-in. (0.063) in diameter can actually be measured.

Electrical signals, developed by the electronic circuits associated with the ultrasonic transducer, are fed to a C-span recorder to provide a permanent map-like presentation of the location, size, and shape of voids or imperfections in a plan view of the heat sink. This provided a valuable record for correlative studies.

Eddy-current conductivity measurements were made on the finished copper surface, before polishing, to determine the presence of flaws in the outermost copper layer (0.015-in. deep). Measurable changes in electrical conductivity of the outer layer, as detected by eddy-current instrumentation, augmented ultrasonic testing, which is not sufficiently sensitive to skin defects.

2. Chemical Analysis

(a) Purity

The purity of the electroformed copper was determined by dissolving an accurately weighed amount of the copper in an acid solution and depositing the copper on a platinum cathode in a Controlled Potential Electro-Analyzer. Comparative tests performed on OFHC copper as a standard gave mean values of 99.965 per cent copper for OFHC and 99.97 per cent for electroformed copper.

(b) Impurity level

The concentration of metallic impurities in electroformed copper was determined by the use of a Jarrell-Ash, 3.4 Meter, Ebert Grating Spectrograph, using a d-c arc and an external standard.

The values obtained by spectrographic analysis are shown in Table II.

TABLE III

COMPARISON OF GAS CONTENT IN HEAT SINK COPPER AND IN OFHC COPPER

	Heat-sink Electroformed Copper	Cast OFHC Copper
Per Cent Nitrogen	<0.0001–0.0001	<0.0001–0.0001
Per Cent Oxygen	0.0002–0.0009	0.0006–0.0010
Per Cent Hydrogen	<0.0001–0.0001	<0.0001–0.0002

Fig. 10. Completed heat-sink undergoing vibration test.

(c) Gas content

A National Research vacuum-fusion gas-analysis apparatus was used for determining the concentrations of nitrogen, oxygen, and hydrogen in the electroformed copper. Table III shows a comparison of the gas content in the electroformed heat sink and in OFHC copper.

3. Physical Tests

The standard bend and chisel tests were performed to evaluate bond strengths of copper-to-copper and of copper-to-stainless steel. The bend test was also modified by first notching (sawing through the copper to the stainless steel base) in the area where bending will take place. The latter has proven to be a very severe test of bond strength.

The tests above (bend and chisel) are definitely limited where quantitative data are sought; but, as the result of many correlative tests, it was determined that where no separation could be effected by driving a chisel between the copper-copper interface or the copper-stainless interface the bond strength exceeded 25,000 psi. When separation could be effected, the bond strength was below 25,000 psi.

Thermal shock tests were performed on the copper-stainless composite by heating the part to 1850F for 5 min, followed by rapid quenching in cold water, repeated several times. Thermal shock tests did not cause separation of a well-bonded deposit.

The most severe test for evaluation of the copper-to-copper bond strength was the transverse section bend test. The material to be tested was first heat-treated at 1200F for 3 hr in nitrogen. Transverse sections 1/8-in. thick were machined normal to the copper-stainless interface. The sample was then bent 90 degrees around a ½-in. radius pin in a special holding fixture (Fig. 6). Any defective layers will separate when the outside surface of the sample is put in biaxial tension. As stated previously, this test was performed on the test plates and proved to be a valuable tool in determining whether or not electroforming should proceed.

Tensile tests for quantitative determinations of the strength of the bond between copper and stainless steel were accomplished by a modification of the Ollard test. The modified test is an improvement over the Ollard test in that there is no likelihood of the specimen being placed in shear rather than tension. A schematic of the test apparatus and photographs of the samples are shown in Fig. 7. Tensile tests performed on the bond between copper and stainless steel on heat sinks ranged from 34,400 to 39,900 psi. The 34,400 psi represents the maximum stress on the bond, not bond strength, because failure was in the copper layer.

Resistance to shear stress was also measured by a physical test. In this test, the copper is cut through to the stainless steel base and the latter is cut through to the copper, the cuts being separated by a distance equivalent to the copper thickness. When the bar (½ by ½ by 8 in.) is placed in a tensile-testing machine, a load is applied parallel to the bond, shearing the copper-stainless steel interface. One difficulty with this test is that the sample can be twisted so that tension rather than shear is actually measured. Avco-RAD tests on heat-sink samples indicate a remarkable uniformity in shear strength. All samples yielded values between 20,000 and 22,000 psi.

Tensile tests performed at room temperature on electroformed copper which had been stress-relieved gave consistent tensile-strength values of the order of 31,000 psi, yield strengths of 12,000 to 22,000 psi, and elongation values of 22 to 56 per cent (Fig. 8). Generally, the higher elongation values were recorded when the specimens were tested in a direction parallel to the interface between the copper and the stainless steel.

4. Metallography

Metallographic techniques were used to correlate nondestructive test procedures in heat-sink evaluation studies, and to establish causes for failures revealed by physical testing.

Fig. 9 indicates the intricate contour machining and polishing performed on the electroformed copper required to meet the surface finish specified for the heat sink. Fig. 10 shows the completed unit undergoing a vibration test just prior to shipment to a Titan test site.

ACKNOWLEDGMENTS

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He entered the metal finishing field in 1951 in the lighting and rectifier department of the General Electric Company in Lynn, Massachusetts, where he held both technical and supervisory positions. His activities included the development of a conveyorized process for brightening and anodizing aluminum reflectors.

He is a member of the American Chemical Society and the American Electroplaters' Society.

AN OUTLINE OF THE CHEMISTRY INVOLVED IN THE PROCESS OF CATALYTIC NICKEL DEPOSITION FROM AQUEOUS SOLUTION

PART II

by G. GUTZEIT*

Catalysts

In connection with the heterogeneous reaction mechanism proposed above, the question of catalytic activity arises. For instance, a specimen of mild steel or of aluminum and its alloys immersed in the solution will start plating almost instantaneously; while this is not true for copper or copper alloys, where electrical (cathodic) initiation is required.

Actually, only nickel and most other metals of the VIIIth group (Periodic System) in active form (i.e., when freshly precipitated) are autocatalytic for the dehydrogenation reaction of hypophosphite. If a metal more electropositive than nickel, such as iron or aluminum, is placed into a properly compounded bath, a displacement reaction takes place, which supplies a catalytic surface:

$$Fe^{\circ} + Ni^{++} \longrightarrow Ni^{\circ} + Fe^{++}$$

The following tests illustrate this fact:

The solution used was the same as the bath designated LP already mentioned, but did *not* contain any nickel ions. The reaction was followed by measuring the volume of hydrogen gas evolved (reduced to standard conditions) during 15 minutes, and by analysis of the solution for hypophosphite and phosphite.

A cleaned and pickled "Armco" iron coupon of 20 cm² area was immersed into 50 cm³ of the nickel free bath having a *p*H of 4.5, at a constant temperature of 100C. Hydrogen evolution was 10.6 cm³ STP or 0.00047 mols. The weight loss of the sample was 0.0002 mols of iron. The hypophosphite concentration did not decrease, and no phosphite was formed. This indicates attack of the metal by hydrogen ions ($2H^{+} + Fe^{\circ} \longrightarrow Fe^{++} + H_2$).

The same test was repeated using a coupon of solid rolled nickel. The hydrogen evolution was only 1.1 cm³ in 5 minutes. The solution contained a trace of dissolved nickel.

An "Armco" iron sample of 20 cm² area was coated with a thin nickel film by displacement (strike) in an acid solution (*p*H 1.5) of nickel sulfate.

$$NiSO_4 + Fe^{\circ} \longrightarrow FeSO_4 + Ni^{\circ}$$

The coupon was removed, then rapidly but thoroughly washed, and immersed into the above-mentioned, hot nickel free bath. Hydrogen evolution started immediately, but slowed down perceptibly after 6 minutes. The volume of H_2 (converted to dry gas under standard conditions) was 5.8 cm³ after 15 minutes.

An "Armco" iron sample of 20 cm² area was coated with chemical nickel, rinsed rapidly and immersed into the nickel-less bath. Hydrogen evolution was substantial for about 5 minutes, then slowed down and entirely stopped after 16 minutes. The volume (STP) of H_2 evolved in the above test was 5.7 cm³ in 15 minutes. Both test solutions showed an increase in phosphite concentration.

The two last experiments indicate that freshly precipitated nickel (by displacement or by chemical reduction) is a catalyst for the dehydrogenation of hypophosphite; but that it loses activity after a relatively short time in the absence of nickel ions. This is not true, as mentioned earlier, for palladium or rhodium sponge.

On the other hand, when the bath contains even very small amounts of nickel (0.002–0.005 M), hydrogen is evolved continuously upon immersion of a mild steel sample, showing that the surface remains catalytically active. Supporting data are given in Table VIII:

TABLE VIII

HYDROGEN EVOLUTION IN LOW NICKEL BATH

Ni^{++} Concentration moles/l	Total Hydrogen Evolved cm³ (STP) in 15 min.	Initial *p*H	Final *p*H
0.002	19.2	4.5	4.42
0.003	22.9	4.5	4.40
0.004	23.5	4.5	4.40
0.005	25.3	4.5	4.40
(0.005	26.7	4.6	4.46)

The amount of nickel left in solution was practically constant (59×10^{-4} moles/l) for a given constant initial *p*H, after 15 minutes of deposition.

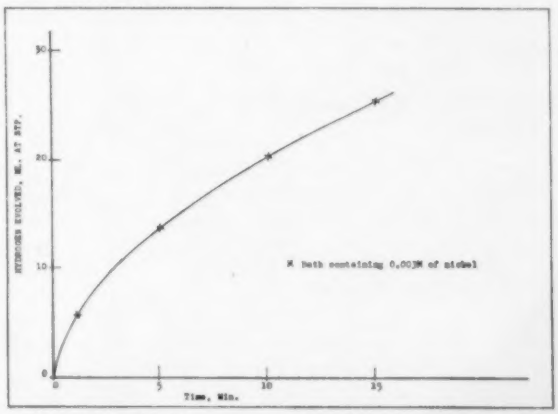

Fig. 7. Rate of hydrogen evolution in bath containing low nickel concentrations

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Rate of hydrogen evolution is high at the start of the test (for about five minutes) then decreases and becomes nearly linear (Ref. Fig. 7 and Table IX):

TABLE IX

HYDROGEN EVOLUTION AS A FUNCTION OF TIME

Ni^{++} = 0.003 M

Time (Minutes)	△t	Hydrogen Evolved cm^3 (Cumulative)	Hydrogen Evolved cm^3 (stp) in △ t min
0	—	—	—
1	1	7.0	7.0
5	4	18.5	11.5
10	5	24.5	6.0
15	5	30.5	6.0
20	5	36.5	6.0
25	5	42.5	6.0
30	5	48.5	6.0

The initial surge is due to the attack of the steel surface by acid (displacement reaction).

It has been shown that the catalysts for the oxidation of hypophosphite are: nickel (active form), the platinum metals, particularly palladium and rhodium (active form), and cobalt (active form in alkaline medium). Therefore, in order to deposit nickel from aqueous solution on other substrata, some form of initiation is required.

If the basis material is a more electropositive metal than nickel, a displacement reaction ("strike") will take place immediately upon immersion into the acid bath. This is true for aluminum, beryllium, ferrous alloys, etc.

If the basis material is a metal less electropositive than nickel, it has to be made cathodic for a short period, in order to obtain a nickel flash on its surface. This can be achieved simply by connecting the solid to be coated with the negative pole of a battery for a few seconds. It can also be done by providing contact in the solution with a more electropositive metal, thus forming an internal voltaic cell. Copper alloys, manganese, etc., can be plated by using such techniques.

If the substratum is a non-metal, it is necessary to bond to the surface—by physical or chemical means—evenly dispersed nuclei of a catalyst, such as nickel or palladium, or of a metal more electropositive than nickel. This can be achieved by mechanical means,[16] or by adsorption of a salt which is then reduced.[17] For instance, parts made from phenolic resins are first lightly abraded, then immersed into a solution containing a few hundred parts per million of Pd^{++} (as the chloride), rinsed in water, and treated in a solution of sodium hypophosphite (0.2 M).*

The active metals of Group VIII of the Periodic System mentioned above are well-known hydrogenation-dehydrogenation catalysts.[18] The presence of phosphorus (even in a combined form)[19] does not seem to interfere with this activity —it may even enhance it—but the sensitivity to "poisons" appears to be increased.

At our suggestion, The International Nickel Company, Inc. requested its Senior Fellow at Mellon Institute, Dr. J. T. Carriel, in 1956 to perform some dehydrogenation tests, using supported nickel-phosphorus catalysts—which were prepared by depositing a thin coating of chemical nickel on high area substrata.

The results pertinent to our subject as reported by Dr. Carriel are summarized below:

The catalysts were evaluated for the conversion of cyclohexane (Phillips Petroleum Co., pure grade) to benzene under the following conditions:

Pressure, psig	200	
Liquid Hourly Space Velocity vol liq/vol cat/hr	1.0	
Hydrogen to Cyclohexane Ratio	2.8	
Average Residence Time, seconds	5–7	

Analyses were performed by gas chromatography.

Designation (Sample)	5A	11A
Support Material	Alumina	Bauxite
Nickel content, per cent	2.0	4.6
Specific surface area m^2/g	140	115

Table X shows some of the results, proving the dehydrogenation activity of chemical nickel. When the cyclohexane feed contained 0.1 per cent sulfur as 2-ethylhexyl mercaptan, the catalysts were completely "poisoned."

Anti-Catalysts

Brenner and Riddell[2] had already shown qualitatively that the presence of certain impurities in the electroless nickel plat-

*Patented in the United States and abroad.

TABLE X

Catalyst	5A			11A			11A		
Temp. of 16 hrs. pretreatment with hydrogen	540C			370C			540C		
	Bed Temp °C	Benzene %	MCP* %	Bed Temp °C	Benzene %	MCP* %	Bed Temp °C	Benzene %	MCP* %
Liquid Products at Several Average Bed Temperatures from pure Cyclohexane	390	3.0	0	361	13.9	0	358	9.4	0
	409	7.0	0	375	32.1	0	371	16.6	0
	423	16.9	0	382	39.0	0.5	383	28.9	1.4
	454	42.2	0	402	38.2	1.5	393	37.1	2.4
	460	63.4	0	418	56.8	1.5	412	60.3	3.0
	475	80.2	0	437	71.1	2.9	430	76.8	3.5

*MCP—methylcyclopentane.

ing bath decreases the rate or even stops deposition. Table XI reproduces their data relative to the acid-nickel solution: creases the rate or even stops deposition. Table XI reproduces their data relative to the acid-nickel solution:

TABLE XI

EFFECT OF IMPURITIES ON PLATING RATE ACCORDING TO BRENNER & RIDDELL

Impurity	Concentration g/l	Effect
Copper sulfate—$CuSO_4$	0.1	Rate decreased
Zinc chloride—$ZnCl_2$	0.1	Normal
Cadmium chloride—$CdCl_2$	0.1	Rate decreased
Magnesium chloride—$MgCl_2$	0.1	Normal
Aluminum chloride—$AlCl_3$	0.1	Normal
Ferrous chloride—$FeCl_2$	0.1	Normal
Potassium thiocyanate—KSCN	0.1	No deposition
Lead chloride—$PbCl_2$	0.1	No deposition
Potassium cyanide—KCN	0.01	Normal

These authors also mention that lead cannot be coated by electroless nickel.

Actually, plating is never successful on the following common substrata: lead, cadmium, zinc, bismuth, arsenic, antimony, molybdenum, tin, tungsten and alloys containing substantial amounts of these elements.

The "poisoning effect" of a large number of ions and molecules has been studied in General American's Laboratories. These anti-catalysts are identical with those which have been found to slow down or prevent hydrogenation-dehydrogenation catalysis.[34] The following data are but a few examples:[20]

Ten-minute rate tests were performed on degreased, electrocleaned and pickled low carbon steel samples having a surface area of 20 cm^2, at 98.5C, in 50 cm^3 of an inherently unstable bath containing 0.09M of nickel (as nickel hypophosphite), 0.045 M of sodium hypophosphite, 0.06 M of sodium succinate (and 0.18 M of sodium chloride) at a *p*H of 4.6.*

The deposition rates R are expressed in $g/cm^2/min$.

Added Anti-catalyst, ppm	None	Pb^{++} 50	SeO_3^{++} 5	$S_2O_3^{--}$ 10	CNS^- 5	HS^- 1
Wt. gain	0.0948	0.0001	0.0034	0.0049	zero	zero
Plating rate R × 10^4	4.74	0.0	0.17	0.02	0.0	0.0

Reaction Efficiency (Hypophosphite Utilization)

Referring to reactions VII, VIII and IX, it can be seen that two hydrogen atoms are required in order to reduce one nickel ion to the metal. The hydrogen atoms, of course, are thereby oxidized to hydrogen ions. Unfortunately, the rate of reactions VII and VIII is much faster than that of reaction IX, so that there is produced an excess of short-lived atomic hydrogen, which results in the formation of hydrogen gas according to:

$$2H \longrightarrow H_2 \qquad \text{(XI)}$$

This reaction was already discussed (II) in connection with the catalytic oxidation of hypophosphite in acid medium (independent of nickel-phosphorus deposition).

$$[H_2PO_2]^- + H_2O \xrightarrow{\text{Cat. (Pd°)}} H[HPO_2]^- + H_2$$

There is a relationship between solution *p*H and the rate of hydrogen evolution within certain limits; and also—as could

*Patented in the United States and abroad.

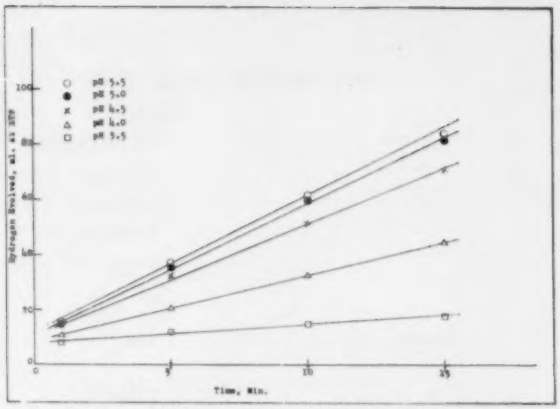

Fig. 8. Rate of hydrogen evolution in LP baths having various starting pH values.

be expected—between nickel deposition and H_2 evolution. The following data are illustrative:

The plating solution was an LP bath containing 0.08 M of nickel cations (as nickel sulfate); 0.225 M of hypophosphite anions (as sodium hypophosphite monohydrate); 0.3 M of lactic acid; 0.03 M of propionic acid, and a stabilizer (Pb^{++}).* Armco iron coupons of 20 cm^2 area were used, immersed in 250 cm^3 of bath, at constant temperatures (90 and 99C). The evolved hydrogen was collected and its volume was measured, then reduced to standard conditions.

TABLE XII

HYDROGEN EVOLUTION AT 90C

Initial *p*H	*p*H after 15 min plating	Nickel deposited (moles)	H_2 evolved cm^3 at STP	H_2 evolved (moles) minus blank	Per cent P in deposit	Ratio H_2 evolved/Ni depos.
3.5	3.45	0.00024	12.9	0.0006	14.6	2.42
4.0	3.90	0.00103	39.9	0.0018	10.3	1.73
4.5	4.21	0.00191	65.9	0.0029	9.4	1.54
5.0	4.45	0.00228	76.9	0.0034	8.7	1.50
5.5	4.55	0.00245	79.6	0.0036	7.5	1.45

HYDROGEN EVOLUTION AT 99C

Initial *p*H	*p*H after 15 min plating	Nickel deposited (moles)	H_2 evolved cm^3 at STP	H_2 evolved (moles) minus blank	Per cent P in deposit	Ratio H_2 evolved/Ni-depos.
4.0	3.9	0.00165	67.8	0.0031	12.6	1.9
4.5	4.0	0.00265	98.6	0.0044	9.3	1.7
5.0	4.3	0.00328	114.7	0.0051	8.9	1.6
5.5	4.4	0.00372	129.4	0.0058	—	1.5

Some of the most important results of this investigation are plotted. (Figs. 8 and 9). They show that the rates of hydrogen evolution (after the first minute, where the excess is due to dissolution) are constant for each *p*H value, and further are a direct function of hydrogen ion concentration.

At *p*H 6.0 the rate of hydrogen evolution approaches a steady value (homogeneous oxidation of hypophosphite). As already stated, the plating rate also increases with the *p*H of the bath. The total amount of hydrogen evolved is directly proportional to the weight of nickel (plus phosphorus)

*Patented in the United States and abroad.

TABLE XIII

HYPOPHOSPHITE UTILIZATION DATA AT VARIABLE NICKEL CONCENTRATIONS

Bath:

Nickel: variable
Hypophosphite: 0.215 M ± 0.009 M
Sodium succinate: 0.06 M
Stabilizer (Pb^{++})
Temp. 99C ± 0.05C
*p*H 4.6

$Ni^{++}/[H_2PO_2]^-$	0.243		0.359		0.450	
	Ni^{++}	$[H_2PO_2]^-$	Ni^{++}	$[H_2PO_2]^-$	Ni^{++}	$[H_2PO_2]^-$
Time (min)	M	M	M	M	M	M
0	0.050	0.206	0.0783	0.218	0.0981	0.218
5	0.0332	0.174	0.0581	0.174	0.0816	0.172
10	0.0227	0.154	0.0454	0.143	0.0718	0.145
15	0.0184	0.132	0.0396	0.124	0.0612	0.125
20	0.0159	0.121	0.0368	0.118	0.0538	0.108
30	0.0128	0.105	0.0320	0.101	0.0523	0.094
45	0.0085	0.085	0.030	0.085	0.0495	0.076

deposited and fits a stright line equation of the form y = b + mx, as shown by Fig. 10 for the two tests reported in Table XII. The slopes are respectively 1.27 and 1.32—and average 1.3 for all experiments. When extrapolated to zero nickel deposit, each run shows a different intercept (b), indicating a variable amount of hydrogen evolved independently of nickel deposition. The molar ratio of total hydrogen formed in the reaction (including hydrogen ions and evolved molecular hydrogen) to one mole of nickel deposited is then 1: (1.0 + 1.3 + b). This expression also represents the rates for reactions VII and VIII to IX. Direct determinations of reaction efficiency (hypophosphite utilization) by analytical methods give values from 0.30 to 0.35 expressed as the mole ratio of nickel plated to hypophosphite consumed, and thus confirm fairly well the above discussion, considering the accuracy of the available methods. (An average hypophosphite utilization of 0.33 ± 0.04 has been observed during six years of large-scale industrial plant operation.) The data of Table XIII are examples of experimental laboratory results.

Triplicate solution samples were pipetted at the time intervals indicated, and analyzed for nickel and hypophosphite.

Identical tests were performed at $Ni^{++}/[H_2PO_2]^-$ moles ratios of 0.621–0.0754 and 1.43 and 1.85. The average hypophosphite utilization (efficiency) calculates to 0.345 ± 0.07.

(To be continued)

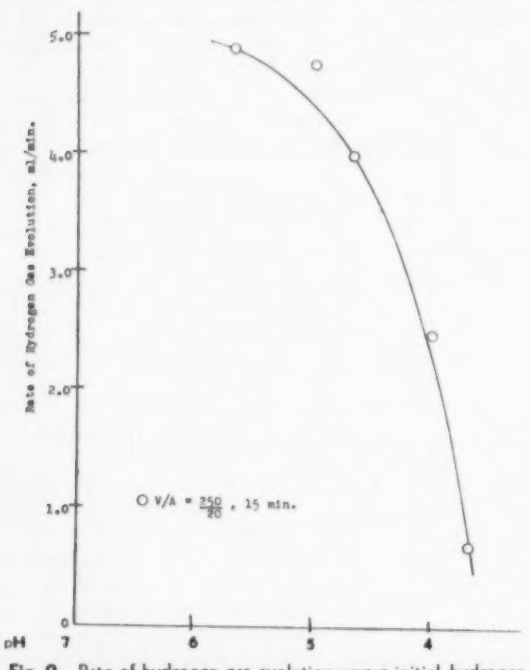

Fig. 9. Rate of hydrogen gas evolution versus initial hydrogen ion concentration in the LP bath.

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[19]Brown, O. W., C. S. Rohrer, and N. P. Sweeny, Jrnl. Amer. Chem. Soc. **80**, 1958, 799.

[20]U. S. Patent 2,762,723 to P. Talmey and G. Gutzeit, Sept., 1956 (Filed June 3, 1953), Assignor GATC.

[21]"Advances in Catalysis" (Academic Press, Inc., New York, N. Y., 1951) Vol. III "The Poisoning of Metallic Catalysts" by E. B. Maxtel, pp. 129–176.

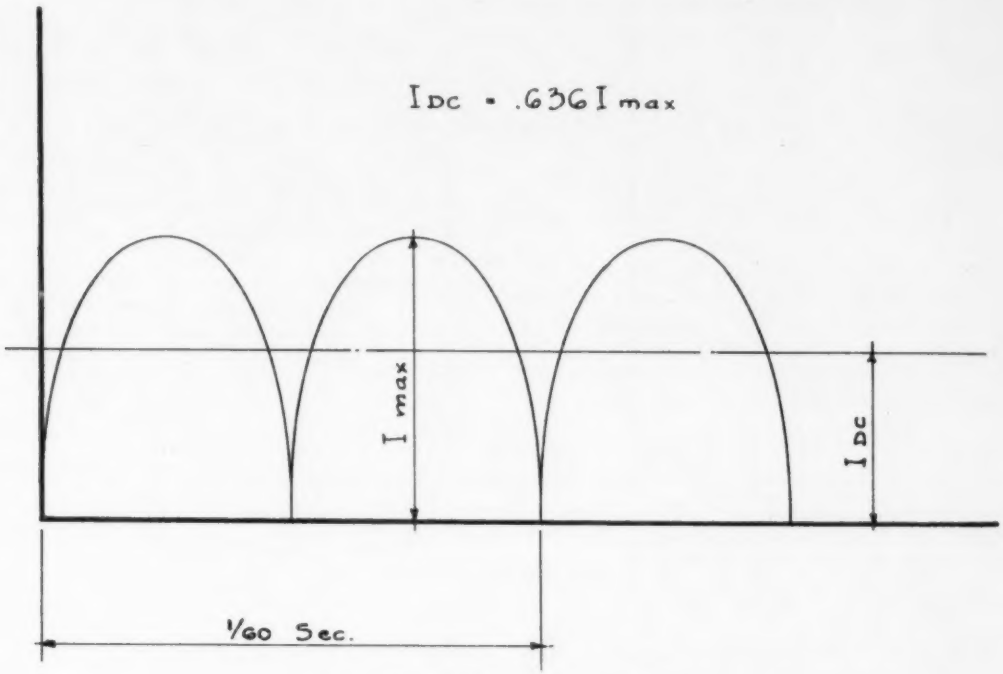

Fig. 1. Wave form of rectifier output current.

AC RIPPLE IN RECTIFIER OUTPUT

by FRANCIS A. SCHNEIDERS*

MUCH HAS BEEN WRITTEN and discussed about ripple during the past few years. Advertisers have capitalized on the theme that particular rectifiers are low in ripple, and the greatest concern has been expressed about the effect of ripple on plating processes but very few actual cases of the detrimental effects of ripple have been substantiated. The only case which has come to the author's attention is the formation of laminated plate during hard chrome plating at low voltages. Regardless of the effect of ripple on plating operations, it is desirable to measure ripple as an indication of the performance of a rectifier. For instance, a normal six phase or three phase full wave rectifier will have a ripple of four per cent when it is operating perfectly. If one of the phases should become inoperative for any reason the ripple of the unit will jump to approximately 10 per cent, and if two phases become inoperative the ripple will jump to 50 per cent. These are measurable values and constitute an accurate measure of the performance of a rectifier.

Ripple is defined as the ratio of the alternating current components in the output of a rectifier to the average or direct current component. The value of direct current is equal to the average value of the output current, i.e. the value of current normally read on a direct current ammeter. To understand this concept better the output of a single phase direct current rectifier will be studied. Fig. 1 shows the unfiltered output of the rectifier with a resistive load. The average or direct current is found by measuring the area between the current curve and the horizontal axis and dividing by the distance along the horizontal axis:

$$I_{DC} = \frac{\text{Area under curve}}{\text{Time}} \qquad \text{Equation 1}$$

or in this case:

$$= \frac{2I \text{ max} \int_0^{\pi} \text{Sine } wt.}{2\pi} = .636 \text{ Imax.}$$

It can be seen from the figure that while a constant reading is obtained on a direct current meter the current actually varies above and below this value in an alternating but regular fashion. In effect this is alternating current super-

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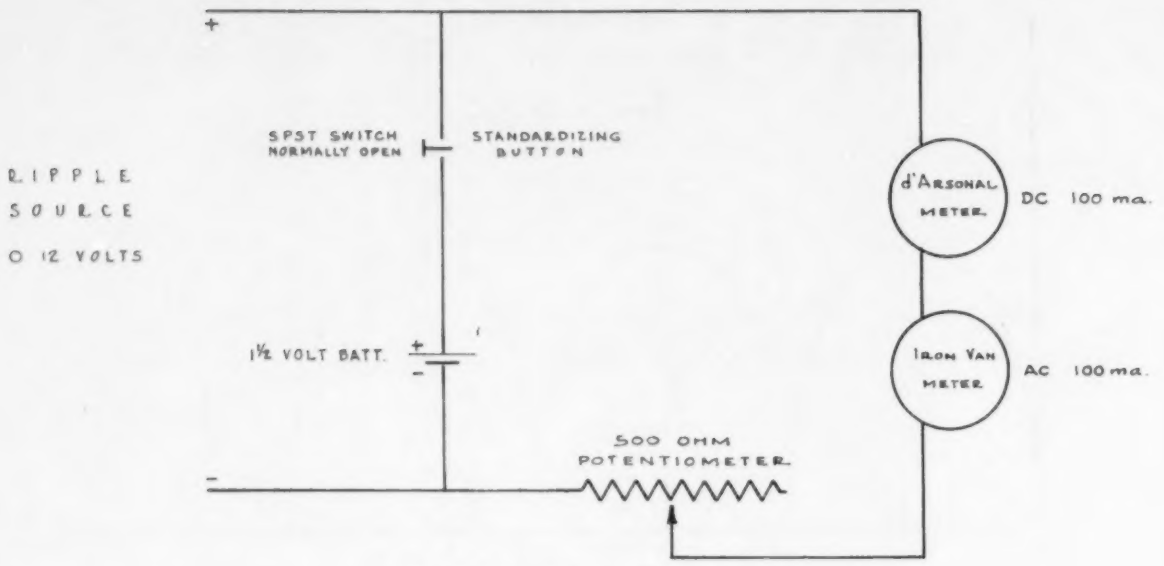


Fig. 2. Schematic diagram of ripple meter.

imposed on the average or direct current. Unfortunately, the wave form of the alternating current is irregular and it is in the analysis of this wave form that some definitions of ripple differ. It is possible to analyze the wave form by complicated mathematics but the use of this technique does not lend itself to easy application. A rough visual analysis will show us that the alternating current portion of the output has a fundamental frequency of 120 cps and possibly major components at 180 and 240 cps. Therefore, a standard iron vane type instrument can be used to measure the alternating current without introducing too serious an error because of the change in the frequency of current measured. The greatest error is at the higher frequencies where the magnitudes of the harmonic current components are a minimum. The use of this simple procedure for the measurement of the alternating and direct current components accommodates most of the definitions of ripple which have been proposed.

The iron vane alternating current ammeter measures a value that is called the root mean square current. (I_{rms}.) The rms current is defined as the current which when flowing through a pure resistance will produce heat at the same average rate as its equivalent direct current. The mathematics necessary to derive the value of current for a single phase rectifier will be omitted but the result is:

$$I_{rms} = (I_{ac}^2 + I_{dc}^2)^{\frac{1}{2}} \qquad \text{Equation 2}$$

The alternating current portion is therefore:

$$I_{ac} = (I_{rms}^2 - I_{dc}^2)^{\frac{1}{2}} \qquad \text{Equation 3}$$

The definition of ripple may be chosen to make use of these readily obtainable measurements:

$$\text{Ripple factor} = \frac{I_{ac}}{I_{dc}} = \frac{\text{Effective value of AC Components}}{\text{Average or DC components}} \qquad \text{Equation 4}$$

$$\text{Per cent ripple} = \text{Ripple factor} \times 100$$

Substituting Equation 3 in Equation 4:

$$\text{Ripple factor} = \frac{(I_{rms}^2 - I_{dc}^2)^{\frac{1}{2}}}{I_{dc}} = \left(\frac{I_{rms}^2}{I_{dc}^2} - 1\right)^{\frac{1}{2}} \qquad \text{Equation 5}$$

I_{rms} = rms current measured with iron vane AC ammeter.

I_{dc} = average current measured with a DC D'Arsonval ammeter. Since both I_{rms} and I_{dc} are readily measurable, ripple factor and per cent ripple may be calculated easily.[2]

There are several methods which can be used to measure I_{rms} and I_{dc}. The device pictured in Fig. 2 will allow the accurate measurement of these values using inexpensive instruments. The use of milliammeters with a range of 100 ma. is recommended since the instrument may then be used to measure ripple of many small laboratory rectifiers without impairing its efficiency in the measurement of ripple in the output of the largest rectifiers commonly encountered in the plating industry. The value of the potentiometer (R) may have to be altered to suit conditions with 500 ohms being suitable for rectifiers up to twelve volts, while it will be necessary to use a 1000 ohm resistor when the unit will be used in the 12–24 volt range. The use of a standardizing loop enables the use of inexpensive milliammeters since the meters may be standardized in the range where they are to be read. Any inaccuracies in the instruments are thus mini-

TABLE I

Type of Rectifier	Per cent Ripple
Single phase—Half wave	123
Single phase—Full wave	46
Three phase—Half wave	18
Three phase—Full wave	4

Note The above values are approximate and may vary according to specific conditions.

mized. The procedure for the use of the instrument is as follows:

1. Depress standardizing button and adjust the potentiometer so that the DC milliammeter reads 50 ma.
2. Adjust the AC meter to read 50 ma using the adjusting screw at the front of the meter. If unable to bring the meter to 50 ma, change the front adjustment on the DC meter and repeat above.
   This adjustment should be checked periodically.
3. Turn potentiometer knob until resistance is maximum.
4. Connect meter leads to bus bars, being careful to observe polarity.
5. Adjust potentiometer so that DC milliammeter reads exactly 50 ma. Read the AC milliammeter.
6. Refer to Fig. 3 to determine the ripple.

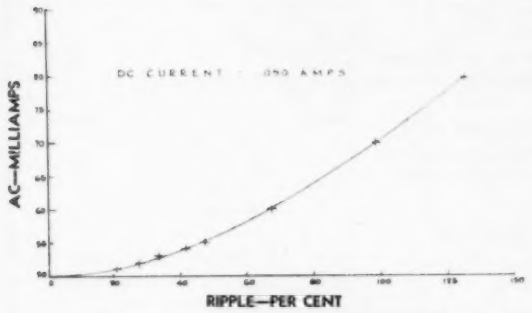


Fig. 3. Per cent ripple vs ripple meter reading.

The ripple of most of the rectifiers encountered in the plating industry is tabulated in Table 1. It can be seen from these values and Fig. 3 that any single phase or three phase half wave rectifier may be analyzed, using the procedure outlined above. If one phase in the three phase half wave rectifier should become inoperative the ripple of the unit would jump from an initial 18 per cent to approximately 50 per cent which would be immediately obvious. The use of the described instrument on commercial three phase full wave rectifiers is somewhat more complicated because of the lower initial value of ripple and the difficulty of obtaining accurate measurements in this range. A new rectifier in good condition has a ripple of approximately 4 per cent. With one phase inoperative the ripple will jump to 10 per cent which corresponds to a value of current which is difficult to read on the meters (approximately ½ milliampere difference on the two meters). It is possible to increase the reading and positively identify a defect by successively removing phases of the input current. This can be done by turning one tap switch to zero or removing one of the three input fuses to the rectifier. If the rectifier is in good condition, the output ripple will jump to 10 per cent which will result in some imbalance in the instrument. If one of the two remaining phases is inoperative the ripple will jump to 50 per cent which will produce an imbalance of about 7 ma. on the ripple meter. By repeating this operation and removing one of the other phases from the circuit, the condition of all the phases of the rectifier may be determined.

An alternate method to determine the ripple of a rectifier includes the use of an oscilloscope and a calibrated voltage source. This technique involves the measurement of the average output voltage (E_{dc}) and the alternating component of the output voltage (E_{rms}). Equation 5 may be arranged so that the substitution of these values would allow the calculation of ripple. For a resistive load:

$$I_{rms} = \frac{E_{rms}}{R} \qquad \text{Equation 6}$$

$$\text{and: } I_{dc} = \frac{E_{dc}}{R} \qquad \text{Equation 7}$$

Substituting into Equation 5:

$$\text{Ripple Factor} = \left(\frac{E_{rms}^2}{E_{dc}^2} - 1\right)^{\frac{1}{2}} \qquad \text{Equation 8}$$

The value of E_{rms} may be determined by putting the output of the rectifier to be studied on the vertical deflection plates of the oscilloscope and comparing the magnitude of the ripple voltage with the known output of the voltage calibrator. For voltage calibarators where the calibrated voltage is the peak to peak value the magnitude of E_{rms} may be calculated:

$$E_{rms} = 0.707 \times \frac{\text{E ripple-peak to peak}}{2} \qquad \text{Equation 9}$$

The value of E_{dc} may frequently be determined by comparing the average displacement of the oscilloscope pattern with the calibrated voltage source. In this case E_{dc} equals the voltage calculated from the comparison when a peak to peak voltage calibrator is used. No permanent DC deflection is obtained with many oscilloscopes and it is necessary to measure E_{dc} with an accurate D'Arsonval voltmeter. In any event the values obtained by the outlined procedure may be substituted into Equation 8 and the value for ripple factor calculated.

SUMMARY

The methods outlined make the determination of the ripple in the output of plating rectifiers relatively easy. Each technique has its advantages. The ripple meter is self-contained and may be moved readily throughout the plant for rapid checks of plating rectifiers. The oscilloscope technique offers the advantage of being able to see the output wave form and frequently makes possible the early detection of defects before ripple becomes serious.

ACKNOWLEDGMENT

The author wishes to thank Enthone, Inc. for permission to publish this paper and Dr. Edward B. Saubestre for his helpful suggestions.

Francis A. Schneiders was born in Plainfield, N. J. He received the BSChE degree from Lehigh University in 1950 and was awarded the degree of ADEE in 1954 from New Haven College. From 1950 to 1954, Mr. Schneiders was in charge of the technical service laboratory of Enthone Inc. He served in the US Army from 1954 to 1956 at the Aberdeen Proving Grounds, Maryland, painting and chemical laboratory, doing research and control work on phosphating processes and paint systems. He rejoined Enthone in 1956 where he is sales engineer in western New England. A registered professional engineer in the State of Connecticut, Mr. Schneiders is a member of Tau Beta Pi, American Chemical Society and American Electroplaters' Society.

TENTATIVE PROGRAM
EDUCATIONAL SESSIONS

(As Tentatively Approved by Editorial Board, September 18, 1959)

MONDAY, JULY 25

2:00 p.m. — *THE SECOND ANNUAL "WILLIAM BLUM LECTURE"*
Dr. A. Kenneth Graham, Second Winner of "AES Scientific Achievement Award"

2:30 p.m. — *SESSION A*
"Statistical Analyses Applied to Plating Processes."
"Metal Finishes and Problems in the Missile Field."
"Safety in the Plating Room."

SESSION B
ORGANIC COATING SESSION
(Papers to be announced)

TUESDAY, JULY 26

9:00 a.m. — *SESSION C*
"Recent Developments in Gold Electroplating."
"Thick Gold Deposits."
"Acid Gold Plating."
"Precious Metal Plating in Printed Circuits."

9:00 a.m. — *SESSION D*
"Outdoor and Accelerated Corrosion Test Comparisons."
"Corrosion Resistance Progress Reports."
"New Procedures for Plating Zinc Diecastings."
"Effects of variation in Copper Plating on Corrosion Performance."

1:00 p.m. — *ANNUAL CONVENTION OUTING*

WEDNESDAY, JULY 27

9:00 a.m. — *SESSION E*
"HYDROGEN EMBRITTLEMENT IN METAL FINISHING" SYMPOSIUM
(Five papers to be announced)

2:00 p.m. — *SESSION F*
"HYDROGEN EMBRITTLEMENT IN METAL FINISHING" SYMPOSIUM
(Five papers to be announced)

7:30 p.m. — ROUND TABLE DISCUSSION "HYDROGEN EMBRITTLEMENT IN METAL FINISHING"

THURSDAY, JULY 28

9:00 a.m. — *SESSION G*
"A Study of Variation in Certain Characteristics of Bright Nickel Deposits with Variation in Bath Temperature."
"Magnetic Properties of Electrodeposited Cobalt Alloys."
"Sulfamate Plating Solutions of Cobalt, Iron and Cadmiun."
"Electroless Nickel."

9:00 a.m. — *SESSION H*
"Cleaning Techniques in Electronics Industry."
"Study of Anodic Coatings on Aluminum."
"Solution Transfer in Plating Barrels."
"New Method of Chrome Plating Directly on Aluminum."

2:00 p.m. — *SESSION I*
"Corrosion Problems with Decorative Chrome."
"Dual Chrome Systems."
"Chrome Plating Rifle Barrels."

AES LOS ANGELES CONVENTION TO FEATURE NINE EDUCATIONAL SESSIONS

Pursuing the AES's goal of programming an educational sessions program for the 47th Annual Convention, Los Angeles, July 24–28, 1960, so important to the educational purpose of the Society and its members that it will attract justified wide attendance, the Editorial Board, at its meeting held at National Headquarters, September 18, with Chairman John P. Nichols presiding, tentatively approved an educational package embodying nine sessions encompassing 37 tentatively endorsed papers described to that meeting by Host Branch Educational Sessions Vice Chairman David Seymour in behalf of Host Branch Educational Sessions Chairman Earl W. Arnold who was prevented by business from attending.

Frozen to a package of not more than nine sessions and not more than 37 papers, possibly with fewer if any of the endorsed papers fail to materialize or be approved, the leadoff feature will be the second annual "William Blum Lecture" to be delivered by Dr. A. Kenneth Graham, second winner of the annual "AES Scientific Achievement Award," the Society's highest scientific honor.

Another feature of the 1960 educational sessions Convention package that is being targetted for versatility as well as for educational significance is a two-session, all-day "Hydrogen Embrittlement in Metal Finishing Symposium" that will include ten papers by prominent experts on that subject. The Symposium will be supplemented by a projected round table discussion to occur on the evening of that day. That project is being programmed for the Editorial Board and the Host Branch Educational Sessions Committee by Dr. Harold J. Read, Professor of Physical Metallurgy, Pennsylvania State University, a specially appointed member of that Convention Committee.

Aside from a versatile array of other subjects important to electroplating, metal finishing and allied arts, there will be one full session of four papers on the subject of organic coating. The complete list of the sessions and their tentatively endorsed papers is presented, subject to change, in an adjoining column.

An invited visitor to that Editorial Board meeting was Convention General Chairman Tony Stabile who impressed the Board with his report of the fare being readied for the educational benefit and relaxational enjoyment of the AES's eagerly anticipated 47th Annual Convention to be held in America's "Wonder City", AES's first mass migration to the Pacific Coast for a family assembly.

Others present at that fruitful Editorial Board meeting included G. Ross Davidson, Dr. Henry L. Kellner, James H. Lindsay, Rodney Leeds, Dr. Abraham M. Max, Dr. Joseph V. Petrocelli, William H. Safranek and Dr. Edward B. Saubestre.

Dr. Harold J. Read
He is programming the Los Angeles Convention's "Hydrogen Embrittlement in Metal Finishing" Symposium.

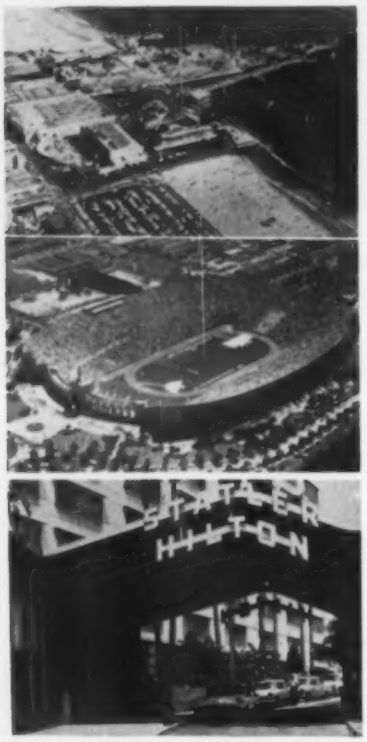
THE EDITORIAL BOARD IN BUSY SESSION, SEPTEMBER 18
(Clockwise, Top, from lower left) Dr. Joseph V. Petrocelli, Dr. Henry L. Kellner, Dr. Abraham M. Max, Rodney Leeds, Chairman Nichols, William H. Safranek (partly hidden), G. Ross Davidson, Dr. Edward B. Saubestre, Los Angeles Convention Educational Sessions Vice Chairman David Seymour, General Convention Chairman Tony Stabile and James H. Lindsay (back to camera). Below, the Board continues its meeting as it lunches.

An Educational Session Meeting Room, Statler Hotel, Los Angeles

David Seymour
He is Los Angeles Convention's Educational Sessions Program Vice Chairman.

AIRLINE DISTANCES TO LOS ANGELES IN STATUTE MILES

Atlanta	1,981	Kansas City	1,360
Boston	2,739	Louisville	1,947
Chicago	1,860	Miami	2,611
Cincinnati	1,910	New York	2,624
Cleveland	2,054	Philadelphia	2,467
Dallas-Fort Worth	1,243	Pittsburgh	2,157
Denver	838	Portland	821
Detroit	2,052	St. Louis	1,589
Houston	1,484	San Francisco	327
Indianapolis	1,819	Seattle	956
		Washington	2,426



LOS ANGELES BRANCH 1960 CONVENTION COMMITTEE AND 1959-60 BRANCH OFFICERS

BACK ROW, left to right, Harvey Hunt, plant visitation chairman and Branch secretary; Don Baudrand, Branch treasurer; William Thomas, banquet chairman; Frank Virgil, Branch first vice president; Norman McEwan, board of managers; Emmett Babcock, Branch second vice president; Claude Weekly, board of managers.
MIDDLE ROW, left to right, Truman Stoner, outing and transporation chairman; Larry Henderson, hotel chairman; Stuart Krentel, printing chairman; Norman Painter, board of managers; Eugene Bosl, convention children chairman; Walter Behlendorf, finance chairman.
FRONT ROW, left to right, Larry O'Neill, convention entertainment chairman; George Hetz, convention co-chairman and branch president; Alice Prescott, convention committee secretary; Dolly Beckwith, ladies chairman; Tony Stabile, convention general chairman; John Millhorn, program chairman; E. W. Wells, convention publicity chairman. Not present when picture was taken, Phil Simon, registration chairman; Earl Arnold, education chairman; Marjorie Farmer, branch librarian; David Seymour, education co-chairman.

(Top left) Aerial view of amusement park on the shore of the Pacific Ocean. (Center left) Los Angeles Memorial Coliseum, largest permanent-seated stadium in the nation. Scene of the 1959 Dodgers-White Sox World Series games. (Lower left) AES members and guests will step through this portal when they arrive at the Statler-Hilton Hotel to attend the 1960 Convention in Los Angeles.

San Fernando Rey de Espana Mission, California, founded in 1771.

Los Angeles looking north from Harbor Freeway toward snow-capped mountains.

AES NEWS

RESEARCH PROGRAM'S GOVERNORS CHECK PROGRAM'S PERFORMANCE

Every aspect of the AES Research Program was carefully reviewed and necessary action taken to fortify it, at the quarterly meeting of the Research Committee, that program's governing body, held at National Headquarters, Newark, September 25, with Chairman James D. Thomas presiding.

The status and performance of each of the seven projects currently operative in American and Canadian universities and foundations were studied, project-by-project, and appraised. On-the-spot direction is being given to each of these programs by Project Directors who are themselves supervised by active Project Committees of experts. Four District Supervisors, in turn, counsel and coordinate respective Projects assigned to them, namely Cleveland F. Nixon (Projects 14 and 15); Clyde Kelly (Project 18); Clarence H. Sample (Projects 12 and 13) and Dr. Edwin R. Bowerman (Projects 16 and 17).

Under Vice Chairman for Finance Kergan Wells, the Committee took serious stock of the urgency to vitalize Program support by industrial companies interested in advancements in plating and metal finishing by stimulating more and more such companies to become, or to reinstate themselves, as Sustaining Members of the AES. The bulk of the financial sustenance of the AES Research Program stems from AES income from such Sustaining Memberships.

It was pointed out that every member of the AES has a personal responsibility to enhance the educational benefits flowing from AES by helping to promote membership increases, particularly Sustaining Memberships financing AES Research. Though the Vice Chairman for Finance of the Research Committee is ex officio a member of the Society's National Membership Committee and liaison thereupon for Sustaining Membership promotion, his own regional organization will be geared to concentrate upon Sustaining Membership increases, with the active aid of Branch Research Finance Chairmen. Each of AES's regional groups (Dixie, Metropolitan, New England, Empire State, Tri-State, Midwestern, Southwestern) is asked to appoint a Regional Research Finance Chairman to coordinate the work of the Branch Research Finance Chairmen of his area, under the overall coordination of the Research Committee's Vice Chairman for Finance.

Members of the Research Committee present at the meeting included Dr. William Blum, Richard A. Fellows, Dr. D. G. Foulke, Edward J. Kubis, Raymond L. Mitchell, Walter E. Moline, John P. Nichols, James S. Thomas and Kergan Wells.

EXECUTIVE BOARD CLEARS HEAVY AGENDA AT ITS AUTUMN MEETING

Attacking one of the most formidable agendas of AES government business in several years, the Executive Board, at its meeting held in Detroit, September 12 with National President Ralph D. Wysong presiding, disposed of the many management matters before it thereby setting the scene for another effective AES operational year.

It received and approved the final Convention report and the certified audit statement of R. N. Derderian & Co., certified public accountants, submitted to it with respect to the GOLDEN JUBILEE CONVENTION held in Detroit, June 15–19, by Convention General Chairman Wright W. Wilson and Convention Finance Chairman John F. Siefen. The AES General Fund was benefitted by $1144.49 income as a result of that successful, versatile Convention, besides the educational and institutional values that stemmed therefrom to the Society and its Branches and members. The Exposition audit will follow.

Aside from completing its 1959–1960 AES committee appointments and manning AES liaison representation with other Societies—exploratory work with the Los Angeles 1960 Annual Convention Committee on its Convention Budget—disposing of a number of policy matters referred to it by respective AES standing committees, including the approval of the Bylaws of the Publications Committee—it also addressed itself to the matters recently channeled to it by the Supreme Society, AES summit governing council.

It also considered and approved the certified audit statement submitted by Clyde A. Zukswert & Co., certified public accountants, resulting from that company's audit of the books of record and financial transactions of the AES, PLATING MAGAZINE and the Research Program for the fiscal year, July 1, 1958–June 30, 1959. A certified extract of that audit report was carried in full in the September 1959 issue of PLATING.

Among other business, it arranged that at least one National Officer will be present at each of the AES's 1959–1960 regional Annual Meetings, including Midwestern, Dixie, Tri-State, Metropolitan, New England and Empire State. It revoked the charter of the San Antonio Branch that had been emasculated by dwindled plating concentration in that community, and it endorsed the transfer of former San Antonio members either to other AES Branches or to Membership-at-Large. It approved plans for the early formal installation of AES's recently permanently chartered new Denver and Phoenix Branches.

Five or the six National Officers were present at the prior evening's Detroit Branch meeting. Nearly 250 Detroit members turned out for that evening's educational session addressed by W. E. Lovell, Ternstedt Division, General Motors Company.

PHOENIX AND DENVER IMPRESSIVELY INSTALLED

At respective impressive meetings, the AES's dynamic new Branches in Phoenix, Arizona, and Denver, Colorado, were officially installed in mid-October 1959 as permanently chartered Branches of the Society. The Phoenix installation occurred in Scottsdale, Arizona, October 9, 1959—the Denver event took place October 13.

The narrative/pictorial account of these significant events will be carried in December PLATING.

AES LITERATURE IN LIBRARIES INTERNATIONALLY

Aside from broad international distribution, the GOLDEN JUBILEE ISSUE (June 1959) of PLATING MAGAZINE has been placed in over 500 American and Canadian university and college libraries. Through the years, these will consequently reach and benefit thousands of members of university and college scientific faculties and student bodies interested in electroplating, metal finishing and allied arts.

Moreover, the AES's Fiftieth Anniversary documentary booklet, "MILESTONES OF AES", having had wide, effective dissemination, is now also on file in college and civic libraries internationally.

AES BRANCH LIBRARIAN'S (USA) 1959-1960

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F. E. Welch, 1209 Thistlewood Lane, West Chester, Pa.
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Joseph Eisenberg, 1800 Cherry Hill Road, Baltimore 30, Md.
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Fred Ploszay, 112 Upland Road, Blacksburg, Va.
BOSTON:
F. Wayne Martin, 30 South Central Ave., Wollaston, Mass.
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Edward Crandall, Old Turnpike Road, Plantsville, Conn.
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Jack W. Peterson, 54240 Ironwood Road, South Bend, Ind.
ST. LOUIS:
Richard Gotsch, 3443 No. Broadway, St. Louis 7, Mo.
SOUTHEASTERN:
Harold E. Willingham, 513 West 23rd Street, Anniston, Ala.
SOUTHERN TIER:
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Vincent P. McConnell, 217 Milford Drive, E. Syracuse 4, N.Y.
TOLEDO:
Edward Agnew, 4405 Walker Avenue, Toledo 12, Ohio
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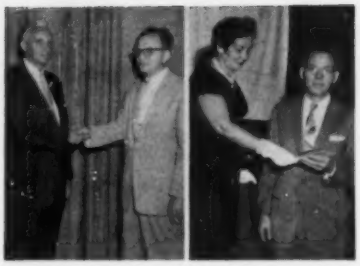
WESTERN ONTARIO:
John McKay, 65 Tweedsmuir Ave., Chatham, Ontario, Can.
WICHITA:
Homer Merserve Jr., 4600 Mt. Vernon Road, Wichita 7, Kansas



LEFT—Metropolitan Regional Group Branch Presidents. Fred Meyer, at left, Newark, shakes hands with New York's Joseph A. Rembecki. RIGHT—Mrs. Louis Donroe presents award memorializing her late husband, to the first winner, James Shyne.

METROPOLITAN REGIONAL GROUP LAUNCHED WITH SUCCESSFUL EDUCATIONAL SESSION

Recently organized, and taking its place among the AES's five other existent regional groups into which over half of AES's American Branches are already linked, the new Metropolitan Regional Group, composed of the New York "Mother" Branch and the Newark Branch, held its first Educational Session at the Statler-Hilton Hotel, New York, September 25—a large and successful enterprise, with the "Mother" Branch as host.

With an estimated 200 or more audience present, the Educational Sessions featured two well-known speakers, namely Dr. Edward B. Saubestre, Enthone, Inc., last year's Heussner AES Gold Medal Award winner, who discussed "Metal Cleaning", and A. Mendizza, Bell Telephone Laboratories, who presented, "Plated Coatings for Electrical Contracts". The Educational Session was followed by a much-enjoyed social hour.

A feature was the first presentation of the Newark Branch's "Louis Donroe Award". For the best timely subject introduced during 1958–1959 by a Newark member, the Award was given to James Shyne. The presentation of the medal and cash prize was made by Mrs. Frances Donroe, widow of deceased for whom the Award is a memorial.

A. Mendizza speaking to capacity audience at the Metropolitan Regional Educational Meeting at the Hotel Statler, New York City.

George F. Marotta

MAROTTA HEADS BOSTON CONVENTION EDUCATIONAL PROGRAM

George F. Marotta, who last May served as Educational Sessions Chairman of the Boston Branch's 23rd Annual Technical Meeting and Banquet, has been named Host Branch Educational Sessions Chairman of AES's 48th Annual Convention. It will be held in Boston June 18–23, 1961. The announcement was made to the Editorial Board by General Convention Chairman Louis V. Gagnon.

In that capacity, Mr. Marotta will serve as ex-officio a member of the Editorial Board in 1959–1960, and will become a full-fledged member of that Board responsible for Convention educational sessions, in 1960–1961, his Convention year. He is associated with the Western Electric Company.

TO ALL BRANCH SECRETARIES

1. **The list identifying and authenticating the Delegates/Alternates elected by your Branch for 1959-1960 tenure is due in the hands of the National Executive Secretary by not later than November 2, 1959. The official Return Sheet upon which to list your 1959-1960 Delegates/Alternates for accreditation by the Credentials Committee has already been sent to you. It requires signatures of both the Branch President and Secretary.**
2. **Your Branch, via its accredited Delegates, has been invited to nominate any qualified member of the Society whom it chooses for consideration for AES Honorary Membership. Your choice must be supported by six copies of a statement of your nominee's qualifications. These are due in the hands of the National Executive Secretary by not later than November 15, 1959.**
3. **Your Branch, through its President, will be invited to nominate any member of the Society whom it chooses for consideration for the Charles Henry Proctor Memorial Leadership Award. More information soon.**

1959-1960 AES LIAISON REPRESENTATIVES WITH OTHER SOCIETIES

1. American Society for Testing Materials (ASTM)
   JOHN P. NICHOLS, American Electroplaters' Society, Inc.
   ASTM Committee A-5, Corrosion of Iron and Steel
   AUGUST MENDIZZA, Bell Telephone Laboratories, Inc.
   ASTM Committee B-8, Electrodeposited Metallic Coatings
   DONALD M. BIGGE, Chrysler Corporation
   ASTM Committee D-19, Industrial Water
   HENRY KAFARSKI, Chemical Processing Co.
   ASTM Committee B-7, Sub-Committee VI on the Anodic Oxidation of Aluminum and Magnesium Alloys
   RUSSELL V. VANDENBERG, Aluminum Company of America
2. American Standards Association (ASA) Committee Z-74 Performance of Effluent Air and Gas Cleaning Equipment
   GEORGE SCHORE, Brucar Equipment & Supply Company
   ASA Committee Z-9, Sectional Committee on Safety Codes for Exhaust Systems
   W. R. FIDELIUS, Hanson-Van Winkle-Munning Co.
3. International Council on Electrodeposition & Metal Finishing
   WALTER L. PINNER, The McGean Chemical Co., (Chairman)
   DR. RICHARD B. SALSTONSTALL, The Udylite Corporation
   DR. WALTER R. MEYER, Enthone, Inc.
   MYRON B. DIGGIN, Hanson-Van Winkle-Munning Co.
4. Inter-Society Corrosion Committee
   GEORGE E. BEST, Allied Chemical Corporation
5. Metal Finishing Suppliers' Association
   DR. HENRY L. KELLNER, Lea Manufacturing Co.
6. National Association of Corrosion Engineers
   GEORGE E. BEST, Allied Chemical Corporation
7. National Association of Metal Finishers
   ARTHUR G. PIERDON, Art Metal Finishing Company
8. National Technical Task Committee on Industrial Wastes
   DR. D. GARDNER FOULKE, Sel-Rex Corporation
9. Ohio River Valley Sanitation Commission
   WILLIAM J. NEILL, Columbus Metal Products, Inc.
10. Society for Plastic Engineers
    FREMONT L. SCOTT, The Metal & Thermit Corp.
11. Society of Aircraft Materials & Process Engineers
    MYRON E. BROWNING, The Convair Company

Mrs. Ann B. Marsh

Miss Kathleen Duquette

ANN MARSH RETIRES; KATHLEEN DUQUETTE SUCCEEDS HER

Retiring and moving from New Jersey to Florida, Mrs. Ann B. Marsh leaves AES service on November 6 after seven years of effective and devoted association at National Headquarters. In private life the wife of Richard K. Marsh whose own retirement from the Western Electric Company will soon occur, Mrs. Marsh and her family will establish residence in their new home in Sarasota.

Promoted to Office Manager at Headquarters and Circulation Manager of PLATING MAGAZINE in Autumn 1956, Mrs. Marsh is especially well-known in AES circles as the lady at the National Office who, as head of the Membership Division, has always served as the friend, aide and counsel of the Society's Branch Secretaries. She will be long-missed and long-remembered by the AES family of which she always has been, so proudly, so much a part.

Mrs. Marsh is being succeeded by Miss Kathleen Duquette of Montreal who brings to her new position, a broad record of experience, including long service with Readers Digest, Montreal, and more recently with Parents Institute, Beverly Hills, California. She is an Alumna of Sir George William College of Canada, and is now a resident of New Jersey.

CONTENTS

The Role of the Basis Metal in the Production of Stressed Electrodeposits by *Dr. Joseph B. Kushner*, Kushner Electroplating School

Effect of Shot-Peening Prior to Chromium Plating on the Fatigue Strength of High Strength Steel by *Bennie Cohen*, Wright-Patterson Air Force Base

Loose Abrasive Finishing Machines by *Fred T. Hall*, General Motors Corporation

AES Project No. 14—The Influence of Physical Metallurgy and Mechanical Processing of the Basis Metal on Electroplating
V: Effect of Polishing on the Durability of Nickel Plated Mild Steel by *Dr. Maurice H. Jones and J. Zajdowski*, Ontario Research Foundation

Metal Wastes—Contribution and Effect—Cincinnati Metropolitan Sewage Disposal Service Area by *Fenton H. Dobb*, City of Cincinnati (Sewage Disposal Section)

Ion Exchange and the Pickling of Magnesium Sheet by *Robert E. Anderson*, The Dow Chemical Company

The Use of Bio-assays in the Safe Disposal of Electroplating Wastes by *Dr. Charles M. Tarzwell*, Robert A. Taft Sanitary Engineering Center

Industrial Waste Treatment and Water Reclamation—A Case Study by *Wayne L. Gaspar*, The Maytag Company

Principles of Electrochemistry by *Fred G. Brune*, Chrysler Corporation

Factors Which Influence the Structure of Electrodeposits by *Dr. Abraham M. Max*, Radio Corporation of America

Cleaning, Pickling and Preparatory Surface Treatment by *William P. Innes*, MacDermid, Inc.

Typical Plating Solution—Cyanide Zinc by *Edward F. Foley*, Stratford Chemical Co., Inc.

Alloy Plating Systems for Aircraft Engines by *Bruce E. Scott*, Curtiss-Wright Corporation

Heavy Electrodeposited Metallic and Flame-Sprayed Ceramic Coatings in a High Heat Transfer Aerothermal Environment by *Dr. Stanley Zirinsky*, General Electric Company and *Dr. Dodd S. Carr*, Bart Laboratories & Design, Inc.

Hard Anodizing of Aircraft Fuel Metering Components by *Dr. Harold J. Wiesner and Henry A. Meers*, Bendix Aviation Corporation

Pitting in Thick Chromium Deposits by *Donald R. Millage and Wilbur E. Hague*, The Udylite Corporation

Instrumentation by *Harold A. Kahler*, General Motors Corporation

Design and Engineering Problems in Plating Room Layout and Installation by *Hugh V. McGuire*, Enthone, Inc.

Plating Rack Design and Insulation by *Frank J. Klein*, Rack Processing Company

When and How to Select an Organic Coating by *Harris G. Beck*, The Glidden Company

Vinyl Plastisols and Organosols as Product Finishes by *Fremont L. Scott and William C. Hosford*, Metal & Thermit Corporation

Measurement of Chromium Plate Thickness on Molybdenum Alloy Turbine Buckets by X-Ray Fluorescence by *Dr. William M. Spurgeon and Ottis L. Isaacs*, General Electric Co.

Pattern Plating with Electrodeposits by *Samuel S. Frey*, Oakite Products, Inc.

AES' 1958 TREASURE BOOK OF TECHNICAL KNOWLEDGE STILL AVAILABLE FOR ORDER

Embodying each of the 43 technical papers by experts of nine countries presented before the Fifth International Conference on Electrodeposition and Metal Finishing at the AES's GOLDEN JUBILEE Convention, Detroit, Michigan, June 15-19, 1959, the Golden Jubilee Issue of the AES's book, TECHNICAL PROCEEDINGS (1959 Edition) is nearing completion. Meantime, the Society's limited remaining supply of the 1958 Edition is fast diminishing. Order your copy now.

CONTAINING a full record of the 45th Annual Convention of the American Electroplaters' Society (AES) held in Cincinnati, Ohio, May 19-22, 1958, the AES's 1958 Edition of TECHNICAL PROCEEDINGS publishes, in full, each of the technical papers delivered by experts at the Educational Sessions of that 1958 Convention, including their charts, diagrams, graphs, tables and other illustrations, plus the verbatim discussion that followed their delivery.

It also included the stenotype report of the panel session on "Practical Plating Problems" that was a hit of that Convention.

A larger book than the 1957 edition, it also carries a front section that includes a complete chronological list of AES Conventions and Past Presidents; a day-to-day log of the 45th Annual Convention; a section on the AES Scientific Achievement Award and on the Paper Awards presented at that convention; a full listing of AES's 1958-1959 Boards and Standing and Special Committees and a complete Branch Directory up to date as at September 1, 1958.

THIS book is the only printed medium in which all of the 1958 Convention's technical papers, and the wealth of technical and scientific data that they impart, will be published. Its scope and coverage are demonstrated by its array of papers listed above.

The domestic price of the 1958 Edition of TECHNICAL PROCEEDINGS is $12 per copy including postage. To those ordering from outside of the United States' continental limits, the charge is $15 per copy including postage. All orders must be accompanied by payment in full. Address orders and make checks payable to:

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A limited quantity also exists of the 1957 book at $10 per copy domestic and $12.50 per copy foreign. All orders must be accompanied by payment in full.

"AEROSPACE FINISHING SYMPOSIUMS" PROGRAMMING NEARING COMPLETION

Finalization of the programming of the "Aerospace Finishing Symposium" jointly to be conducted by AES's Dallas-Ft. Worth Branch and the Society of Aircraft Materials and Process Engineers (SAMPE) at the Hotel Texas in Ft. Worth on December 8 and 9, is fast approaching. The program is targeted to serve an expected audience of some 500 AES and SAMPE members and their guests.

Themed to "finishing and protective treatments of aeronautical type materials, components and support systems", the Symposium, in four morning and afternoon sessions, will cover, 1) plating, 2) protective treatments and special processes, 3) organic finishing and, 4) coatings for the future.

A partial list of speakers just released by Program Chairman Myron E. Browning, president of the Dallas-Ft. Worth Branch, includes: Dr. C. L. Faust, Battelle Memorial Institute: G. B. Bowman, Rockwell-Standard Corporation: D. W. Gates, Redstone Arsenal, A.B.M.A., W. F. Smith, Allied Paint Mfg. Co.: M. Rubinstein, Marlane Development Co.; A. S. Dalton, W.A.D.C., Wright Patterson AFB; M. A. Glaser, Midland Industrial Finishes Co.: R. L. Wachtell, Chromalloy Corporation: R. Pettit, The Diversey Corporation: H. M. Farrow, National Research Equipment Corporation; A. Korbelak, Sel-Rex Corporation, and Dr. Harold J. Wiesner, Bendix Products Division, Bendix Aviation Corporation.

It is expected that presented papers will reflect finishing developments, approaches or special techniques applicable to aircraft, space vehicle or missile materials, systems and component parts. Hoped to be emphasized are aspects of finishing related to high temperatures: increased corrosion resistance: improved hyper- and trans-sonic system properties: special fabrication methods and coatings which may be the key to our nation's ventures into space. Reportedly, several forums are being planned. A Finishing Exposition is reportedly being held in conjunction with the Symposium. The five major aircraft companies in the Dallas-Ft. Worth area are supplementary hosts of the Symposium.

An organization meeting that may possibly lead to the formation of an AES Southwestern Region is being planned for December 7. Discussions will also occur as to the possibility of a joint Regional Research Project. The Symposium will be supplemented by a number of relaxational activities, including a final banquet on the evening of its last day.

AEROSPACE FINISHING SYMPOSIUM BEING PLANNED

Planning jointly the first "Aerospace Finishing Symposium" themed to the "Treatment and finishes for aircraft materials" are the above members of AES's Dallas-Fort Worth Branch and of the Southwest Society of Aircraft Materials and Process Engineers: (Left to right, seated) C. P. Waggoner, C. P. Waggoner Co. Grand Prairie; Louis DeChellis, Andrew Brown Co., Irving; J. J. Pulaski, Convair, Fort Worth; Ray Goudeau, Air Accessories, Fort Worth; and Program Chairman Myron Browning, Convair, Fort Worth. Standing, left to right, are Marshall Morris, H. I. Thompson Fiberglass Co., Forth Worth; Al Hohman, Chance Vought, Grand Prairie; Doug Layne, Dow Corning Corp.; Dick Pfaff, Anadite, Hurst, Tex.; Bill Aves, Chance Vought, Grand Prairie; Dick Sharpe, Temco, Garland; Fred Howard, Bell Helicopter, Hurst; and D. C. "Nic" Novelli, Convair, Fort Worth. Novelli, is Chairman for the planning group.

James E. Cogan Jr.

President of the Philadelphia Branch, Mr. Cogan is chairman of the Branch's Fiftieth Anniversary celebration and of that Host Branch's arrangement of the Seventh Interim Meeting of the Supreme Society.

TENTATIVE PROGRAM

FIFTIETH ANNIVERSARY, PHILADELPHIA BRANCH
AND
SEVENTH INTERIM MEETING, SUPREME SOCIETY

BEN FRANKLIN HOTEL, PHILADELPHIA
FEBRUARY 18-21, 1960

THURSDAY, FEBRUARY 18
9:30 a.m.—AES Research Committee Meeting (All Day)

FRIDAY, FEBRUARY 19
9:00 a.m.—AES Executive Board Meeting (All Day)
10:00 a.m.—Registration, Branch Fiftieth Anniversary
1:00 p.m.—Plant Tour
6:00 p.m.—Dinner (Dutch Treat)
7:30 p.m.—GRAND OPENING Session, Branch Fiftieth Anniversary
8:00 p.m.—Educational Session "A"
8:00 p.m.—Joint Meeting, Executive Board, American Electroplaters' Society and Board of Trustees, Metal Finishing Suppliers' Association

SATURDAY, FEBRUARY 20
8:00 a.m.—Registration, Branch Fiftieth Anniversary
8:00 a.m.—Registration, Delegates/Alternates, AES Supreme Society
10:00 a.m.—Seventh Interim Meeting, Supreme Society
12:00 Noon—Seventh Interim Meeting Luncheon (Dutch Treat)
1:00 p.m.—Seventh Interim Meeting, Supreme Society
1:00 p.m.—Educational Session "B"
6:00 p.m.—Fiftieth Anniversary Cocktail Hour
7:00 p.m.—Fiftieth Anniversary Banquet and Floor Show

SUNDAY, FEBRUARY 21
9:00 a.m.—AES Executive Board Meeting

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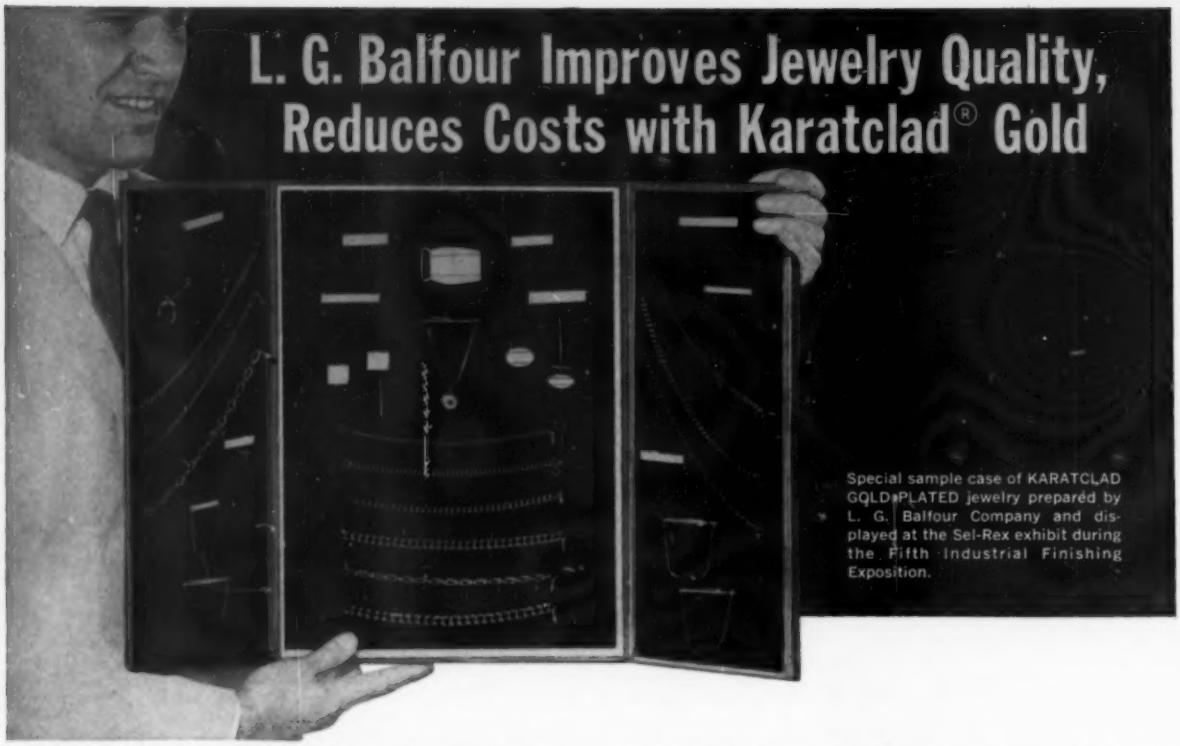

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Porosity of Electrodeposited Metals—By N. Thon, D. G. Kelemen, L. Yang, S. Yang, D. Dean	*Serial 28* *Project 6* *85 Cents*
The Analysis of Electroplating Solutions for Major Constituents—By E. J. Serfass & M. H. Perry	*Serial 29* *Project 2* *90 Cents*
Effect of Basis Metal Condition on Plating, I & II By A. E. R. Westman & A. F. Mohrnheim	*Serial 30* *Project 14* *$1.10*
Effect of Surface Finishing on Nonferrous Base Metals on Protective Value of Plated Coatings—By G. J. Kahan, W. W. Macchia, J. M. Fairbank	*Serial 31* *Project 4* *45 Cents*
How the Small Electroplater Can Treat Cyanide Plating Waste Solutions with Hypochlorites—By Barnett F. Dodge and Walter Zabban, Yale University, New Haven, Connecticut	*Serial 33* *Project 10* *50 Cents*
Effects of Impurities and Purification of Electroplating Solutions, IX, X & XI—By Dr. D. T. Ewing, Dr. A. J. Smith & Dr. W. O. Dow	*Serial 34* *Project 5* *50 Cents*
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The Nature, Cause and Effect of the Porosity in Electrodeposits, I & II—By Fielding Ogburn, Asaf Benderly and Margaret Hilkert	*Serial 36* *Project 13* *$1.00*
Microthrowing Power, A Literature Search—By Esther B. Leffler and Henry Leidheiser Jr.	*Serial 37* *Project 17* *75 Cents*
The Influence of the Physical Metallurgy and Mechanical Processing of the Basis Metal on Electroplating IV—By M. H. Jones, Chih-Yeu Lu and J. Zajdowski	*Serial 38* *Project 14* *$1.25*
Mechanical Finishing of Metal Surfaces—Bibliography—By C. E. Kennedy, J. E. Fritts, R. S. Modjeska, L. E. Weeg & R. V. Twyning	*Serial 39* *Project 18* *50 Cents*
The Nature, Cause and Effect of the Porosity in Electrodeposits, III, IV & V—By Fielding Ogburn, D. W. Ernst & W. H. Roberts	*Serial 40* *Project 13* *50 Cents*
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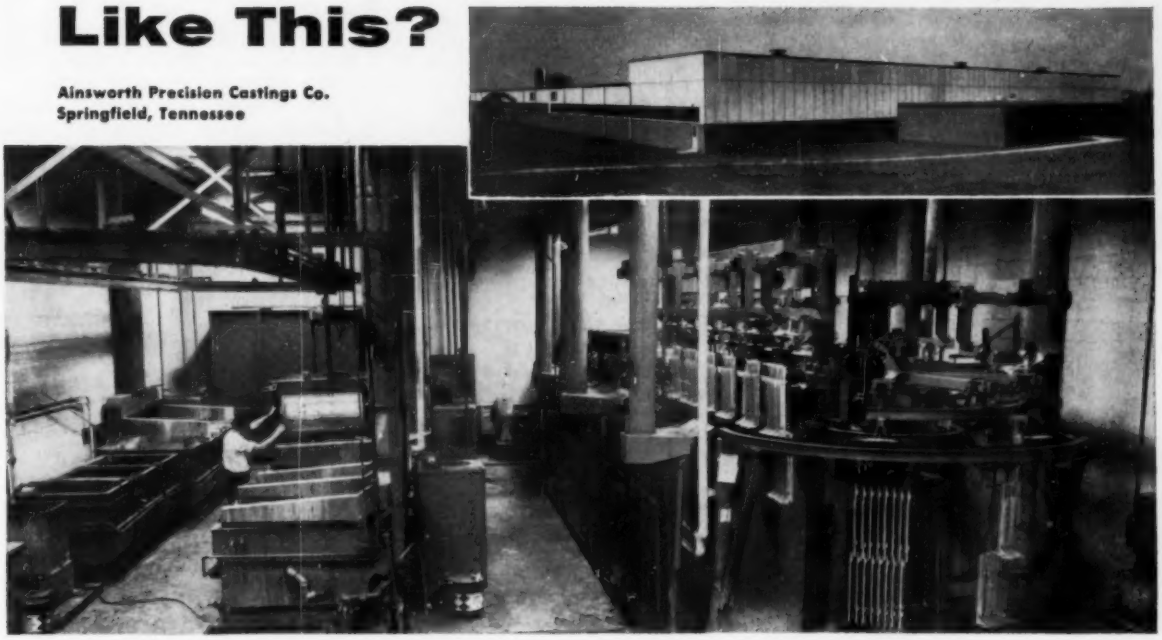

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INTERSOCIETY NEWS

LaQUE HONORED AT ASTM PACIFIC MEETING

Lt. General Bernard A. Schriever, Commander, Air Research and Development Command, U.S. Air Force, was the featured speaker at a luncheon, held by the American Society for Testing Materials, Oct. 14, at the Sheraton-Palace Hotel, San Francisco. The luncheon was part of the ASTM Third Pacific Area National Meeting and honored the Society's president Frank L. LaQue, vice president and manager, Development and Research Division, The International Nickel Company, Inc.

Some 2000 engineers, scientists and executives from industry, government and educational institutions attended the five-day meeting devoted almost entirely to the presentation of technical symposia, papers and reports relating to research on engineering materials and standards for materials of practically all kinds for both defense and civilian use. Over 250 papers were presented in more than 50 technical sessions. Among the subjects discussed were: Electronics, ceramics in nuclear energy, non-destructive testing in the missile industry, hydraulic fluids, spectroscopy, radiation and radioisotope test methods, structural sandwich construction, treated wood for marine use, forum on nuclear problems in materials, radiation dosimetry, building construction, fatigue of aircraft structures, reinforced plastics, concrete, utilization of water and industrial waste water, adhesives, road and paving materials, waterproofing and roofing materials, newer metals, soils for engineering purposes, air pollution control, and irradiation effects in polymers.

PRESIDENT LEONARD NAMES NAMF COMMITTEE CHAIRMEN

Key committee leadership posts were filled recently by A. T. Leonard of Superior Plating, Inc., Minneapolis, president of the National Association of Metal Finishers. Association headquarters are in Cedar Grove, N. J.

Appointments included: membership-public relations, Robert L. Giesel, Adolph Plating, Inc., Chicago; educational, Edward N. Marlette, Marlette Plating Co., Buffalo; constitution and bylaws, James E. Cogan Jr., Globe Electroplating Co., Philadelphia; ethical and standard practices, John T. Hyduke, Durable Plating Co., Cleveland; standards and specifications, Henry A. Kafarski, Chemical Processing, Inc., Detroit; industrial liaison, Charles R. Leva, Levco Metal Finishers, Inc., Long Island, and John Palik Jr., National Plating Corp., Cleveland; liaison, American Electroplaters' Society, James E. Cogan Jr.; and liaison, Metal Finishing Suppliers' Association, Harold W. Baker, Electro-Galvanizing Co., Chicago. An ambitious program is planned for the months ahead by committee chairmen, including the release of industry operating cost data, management manual, industry ethics and standard practices, standards and specifications and a dynamic membership promotion and public relations program.

NEW MATERIALS AND TRENDS AT CHEMICAL EXPOSITION

The 27th Exposition of Chemical Industries at the New York Coliseum, Nov. 30 to Dec. 4, will disclose many indications of trends and a great array of materials, fabrications and functional units. Large scale equipment will also be featured.

A specialist in metallic media for solids-liquid separations will offer wire cloth and filter cloth in corrosion-resistant alloys with particle retention as fine as 5 microns; also perforated metal for filtration with diatomaceous earths, for use in ion exchange towers, carbon towers, catalyst towers and air filters.

Filtration equipment will be featured in many applications. One line alone will combine sealed disc and barrier type filters.

Radioisotopes are employed to energize an entire line of indicating and control systems. Included are a tank level detector controller, a continuous container-fill system, an individual container fill inspection and rejection system and a radical density measuring system based on the transmission of gamma rays through moving materials.

A widely-known research organization will present the latest technical data on the varied materials and finished products in which cobalt is utilized, such as alloys for high-temperature use in jet engines, magnets, springs, dental materials, coatings, glass-to-metal seals, cutting tools, paint driers, varnishes and inks.

Materials for chemical plants and chemical processing will form an important contribution to this year's Exposition. Carbon and graphite products will include the first release of a new type of globe valve and a modular entrainment separator, along with other carbon fabrications to handle any unit operation where corrosion is a problem.

On view, it is promised, will be the first injection molded plastic filter plates ever produced commercially, the first all plastic filter press headers and a new special weave nylon monofilament filter cloth For the laboratory, there will be a sink built of polyethylene, complete with fume hood and outlets.

There will be rotary pumpe with neoprene impellers, PVC centrifugal fans, plastic machined parts, filter membranes, nuts and bolts, and special corrosion resistant components for processing plants.

New at the Exposition will be a full line of plastic products in sheet, tube, fabric and molded forms, produced in France under the name "Gaflon." The line includes valves and cocks and fittings specially designed for handling liquid metals; also a leak detector for low or high pressure systems, especially applicable in nuclear physics research.

SEMINARS ANNOUNCED BY TOOL ENGINEERS

The 1959–60 series of technical seminars on new methods and materials in production, tool and manufacturing engineering has been announced by Gilbert E. Seeley, director of education for the American Society of Tool Engineers, Detroit. "The Society believes that the economic growth of America is dependent upon research and the exchange of ideas," Mr. Seeley said in his announcement. "These seminars are designed to draw from an inventory of practical ideas, proven know-how and shop demonstrated research."

Each topic of the seminar has been selected on the basis of local interest and recent advances in research and industry.

"Problems of Machining Space Age Metals" will be the topic of the first seminar at the Sheraton Hotel in Philadelphia, Nov. 17 and 18. Papers on the superalloys, which are rapidly moving from research to production, will be presented. Also on the program are sessions on machining methods such as electro-discharge and chem-milling, as well as developments in vacuum melted castings and powder metallurgy. This will also be the subject of the San Francisco seminar at the Sheraton Palace Hotel, March 8 and 9, 1960.

Other seminars scheduled are "Metal Forming Methods for Tomorrow's Manufacturing," LaSalle Hotel, Chicago, Dec. 3–4, Ambassador Hotel, Los Angeles, March 3–4, and Bond Hotel, Hartford, Conn., March 23–24; "What We Know Today About Metal Cutting," Sheraton Palace Hotel, San Francisco, Jan. 28–29 and LaSalle Hotel, Chicago, May 12–13.

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INDUSTRY NEWS

ENTHONE SALES MEETING

Enthone, Incorporated of New Haven, Connecticut, subsidiary of American Smelting and Refining Company, recently held its fall sales meeting. The Enthone sales slogan for 1960, "Make Sales Soar in '60," was introduced and each sales engineer was presented with a chrome plated letter opener engraved with the slogan. Sales and technical aspects of the new products of Enthonics developed during the past year were discussed at length. The four-day sales meeting was co-chairmanned by W. K. Murray, manager of marketing, and A. Harry Sanders, New England district sales manager. (Seated, left to right) J. H. Shockcor; T. Brewer, L. H. Butcher Co.; L. J. Durney; C. C. Helmle, vice president and general manager; R. B. Goodsell; A. H. Sanders; D. S. Hartshorn; L. V. Gagnon. (Standing) W. K. Murray; H. M. Goldman; F. A. Schneiders; D. F. Seymour, L. H. Butcher Co.; A. R. Tefft; A. J. Kolb; E. B. Washburn; A. F. Fletcher; J. E. Rhoads; E. B. Saubestre; M. R. Herman, vice president; J. J. Martin; J. R. Eisele. Absent when photo was taken: W. R. Meyer, president.

CARBORUNDUM INTEGRATES TUMBLING AND BARREL FINISHING PROGRAM

A fully integrated program for the manufacture and sale of abrasive tumbling media, barrel finishing compounds, tumbling machines and equipment is announced by Joseph S. Imirie, vice president and George R. Rayner Jr., sales manager of the Electro Minerals Division of The Carborundum Co. in Niagara Falls, New York.

Tumbling, over a period of 75 years, has developed from the crude "shovel-the-parts-in-the-drum-and-see-what-happens" stage to scientific processes of precision barrel finishing.

Nelson L. Watkins, industrial engineer, management consultant on metal finishing and a specialist with over 20 years' experience and scientific study on barrel finishing, heads Carborundum's integrated tumbling program in the capacity of product manager of barrel finishing.

Formerly president of Hydramatic Metal Finishing Inc., Cleveland, Ohio, Mr. Watkins came to Carborundum in 1958. He has collaborated with research, product engineering, and manufacturing in the development of the line of abrasive tumbling media and barrel finishing compounds, together with the tumbling machines and equipment for their application.

Field sales engineers now in their territories are R. C. Bensman services the Buffalo and Pittsburgh districts out of Niagara Falls; John I. Jenkinson, the New England states from West Springfield, Massachusetts; H. S. Holman, the New York and Philadelphia (Bristol) districts; Joseph Laughlin Jr., the Southern district out of Atlanta; R. S. Wilson, the Southwestern district from the St. Louis office; E. J. Schultz the Detroit and Cleveland sales districts; W. F. Quirk, the Chicago district; and E. J. Schweitzer will service the Pacific coast area from the Los Angeles district office. R. W. Fitch and R. A. Murphy, product sales engineers at Niagara Falls, will give engineering support to all field representatives.

BELKE APPOINTS DISTRIBUTOR FOR MICHIGAN

Appointment of Keystone Plating Supplies of Hazel Park, Michigan, as exclusive distributors for the complete line of Belke plating equipment in Michigan territory has announced by Belke Manufacturing Co. of Chicago.

STUTZ ADDS DISTRIBUTORSHIP OF MURRAY-WAY EQUIPMENT

The Stutz Company of Chicago has been appointed a Midwest distributor for products manufactured by Murray-Way Corporation, Birmingham, Michigan.

The firm with offices at 4450 West Carroll Avenue, Chicago 24, Illinois, is headed by George L. and Richard G. Stutz. They have eight salesmen covering Illinois, Southern Wisconsin, Northern Indiana and Eastern Iowa.

The Stutz Company will represent Murray-Way's line of flat polishing and automatic buffing equipment, automatic loaders and unloaders, rotary filters, conveyors, and specially engineered metal finishing systems.

TAMMS APPOINTS HERR CO.

Tamms Industries Co. of Chicago has appointed L. H. Herr Co. of Denver Colorado to represent its Raw Materials in the state of Colorado, and portions of Wyoming and New Mexico.

CORRECTIONS

"*Precious Metals*", PLATING MAGAZINE, Golden Jubilee Issue (June 1959) by Dr. Edward A. Parker, Technic, Inc. Pgs. 621-627.

The original article states in the first sentence, paragraph 5, column 2, page 622, "In the printed circuit field and others, the addition of a small amount of silver has allowed plating to proceed at room temperature and the free cyanide can be maintained in any desired range from less than 0.1 to 15 ounces per gallon". The Sel-Rex Corporation alleges that the plating operation described is covered by Patent No. Re. 24,582 (December 23, 1958) and cautions readers to respect that patent right.

The author has submitted the following statement of corrections:

"The last portion of the first sentence in the fifth paragraph, second column, page 622 should read, '. . . . and the free cyanide can be maintained in any desired range from less than 0.1 to 1.3 ounces per gallon.'

"In addition, references to E. C. Rinker's article on 'Bright Gold Plating' in the 1953 Issue of the AES's TECHNICAL PROCEEDINGS which described the properties of a bright gold plate, and the later Patent No. 2799633 dated July 16, 1957 which disclosed the several brighteners, were inadvertently omitted."

Ed. Note: Before making use of the operation at issue, readers may be well-advised to make their own investigation as to possible patent infringement.

INDUSTRY NEWS BRIEFS

PATENT INFORMATION PAMPHLET PUBLISHED BY GOVERNMENT

Inventors have been provided a new information pamphlet, "Patents and Inventions—An Information Aid for Inventors" just published by the U. S. Patent Office containing basic information as to patenting and patent procedures, and related information which may prove helpful in the development and marketing of inventions. Copies are available through the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., at a price of 15 cents per copy—$11.25 per 100 copies in larger lots—and the Department of Commerce Field Service Offices in cities where such offices exist.

CHARLES ENGELHARD NOW CHAIRMAN AND PRESIDENT

Charles W. Engelhard, chairman, has become president of Engelhard Industries, Inc., Newark, N. J. Gordon V. Richdale has resigned as president. Mr. Engelhard will now assume more active personal control of the administration of the big platinum firm which is expanding its research and development in many areas.

Mr. Richdale joined the firm after a distinguished career with the Bank of England and mining enterprises in South Africa.

Mr. Richdale's desire to devote more time to his interests in other parts of the world is reported to have motivated his decision to resign.

INVESTIGATING APPLICATIONS OF ULTRASONICS TO DIE-CASTINGS

The use of ultrasonics to eliminate porosity, increase surface hardness, and improve the quality of nonferrous die-castings is under investigation by the American Charcoal Co., Detroit.

Experiments already concluded by Dr. J. F. Schrumn, Dr. Mel Allen and Earle W. Rearwin, indicate that ultrasonics will play an important role in future die-casting developments. It is believed that many non-ferrous forgings could be die-cast with the aid of ultrasonics resulting in higher production, lower cost and unprecendented quality.

The application of ultrasonic vibrations to die-castings evolved out of a basic theory that the physical and mechanical qualities of non-ferrous metals such as aluminum and zinc could be improved by sonic vibrations during the liquidus-solidus range.

ELECTRON MICROSCOPE AT ONTARIO RESEARCH FOUNDATION

An electron microscope, Siemens type Elmiscope I, with many accessories, has recently been installed at the Ontario Research Foundation, Toronto, Ontario, Canada.

Because of the structure of light waves, ordinary optical microscopes are limited to a magnification of about 1500 times. Objects smaller than the wavelength of light cannot be seen by these means.

The wavelengths of the electrons as used in an electron microscope are much smaller, and hence much smaller structures may be "seen" provided various conditions are met. It is possible, using the electron microscope, to obtain magnifications up to 200,000 times. This makes it possible to "see" particles of certain materials as small as 0.8 millimicrons.

NEW PORCELAIN ENAMELING PROCESS

A new direct-on porcelain enameling process adaptable to existing plant facilities will be introduced to the porcelain enameling industry in November, by Chas. Pfizer & Co., Inc. The new system, which utilizes citric acid in the pickle bath instead of sulfuric acid, is known as the Ray-Davis Process.

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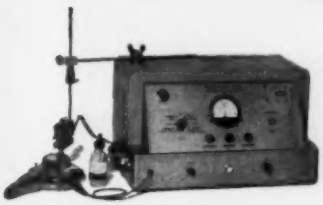

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PATENT ABSTRACTS

DR. D. GARDNER FOULKE
SEL-REX CORPORATION
Nutley, New Jersey

Copies of patents may be obtained by writing to Commissioner of Patents, Washington, D. C. Price 25 cents each.

No. 2,881,711, 4/14/59—Conveyor—John Davis and L. Pianowski, assignors to The Udylite Corp., Detroit, Mich.

Claim 1 states: "Conveyor apparatus comprising a vertically reciprocable lift frame, a discontinuous pusher rod mounted on said frame and horizontally reciprocable with respect thereto, pusher rod segments alignable with said discontinuous pusher rod to fill in the discontinuities thereof, said segments being mounted for reciprocating horizontal travel and being vertically movable relative to said lift frame, and means to couple said segments to said discontinuous pusher rod for reciprocating horizontal drive thereby."

9 claims, 11 figures.

No. 2,882,139, 4/14/59—Manufacture of Buffing Elements—A. Rock, assignor to F. Land and J. C. Codman Co., Rockland, Mass.

A buffing wheel construction is described.

1 claim.

No. 2,882,189, 4/14/59—Phosphate Coating—W. Russell and R. Gibson, assignors to Parker Rust Proof Co., Detroit, Mich.

Claim 1 states:

"An article having a ferrous surface having an iron phosphate coating thereon and an overlayer containing at least 0.6 mg/sq ft and not more than about 15 mg/sq ft of a hexavalent chromium compound calculated as CrO_3."

8 claims.

No. 2,882,208, 4/14/59—Nickel Plating—H. Brown, *et al.* assignor to The Udylite Corp., Detroit, Mich.

A bright nickel process is described wherein the addition agents consist of sulfo-oxygen compounds along with a compound of the structure containing a C ≡ C group separated from a –C ≡ N group by at least one ether linkage.

14 claims.

No. 2,882,209, 4/14/59—Copper Plating—H. Brown and R. Fellows, assignors to the Udylite Corp., Detroit, Mich.

To an acid copper bath add about 0.002–0.03 g/l of a compound selected from 1-acetyl-2-thiohydantoin, 1-protonyl-2-thiohydantoin and 1-trifluoro acetyl -2-thiohydantoin and 0.0015–0.05 g/l of a dyestuff (Janus Green B, Janus Black, etc.).

8 claims.

No. 2,882,214, 4/14/59—Pulley for Wire Plating Apparatus—W. Summers and H. Hasell, assignors to Westinghouse Electric Corp., E. Pittsburgh, Pa.

A contact pulley for a wire plating apparatus is described.

5 claims, 3 figures.

No. 2,833,311, 4/21/59—Composition for Treating Aluminum—D. Halpert, assignor to Vertol Aircraft Corp., Morton, Pa.

Claim 1 states: "The process of treating aluminum and its alloys which comprises immersing the metal in an aqueous solution containing 8 to 98 per cent nitric acid (70 per cent concentrate) and containing fluoride and chromate ions in concentrations corresponding to that obtained in a solution containing 1 to 45 g of sodium fluoride/l of solution and 1 to 400 g of anhydrous chromic acid/l of solution for a time sufficient to initially reduce the surface resistance of the metal to below 100 microhms, removing the metal from said aqueous solution before the surface resistance again reaches 100 microhms and thereafter rinsing the thus treated metal."

6 claims.

No. 2,882,653, 4/21/59—Buffing Wheel—J. Wisniewski, assignor to Lyon, Inc., Detroit, Mich.

A buffing wheel is described wherein good ventilation is obtained.

3 claims, 6 figures.

No. 2,882,654, 4/21/59—Buffing Wheel—S. Mockiewicz and J. Bacha, assignors to American Buff Co., Chicago, Ill.

An abrasive cloth buffing wheel of disc shape is described.

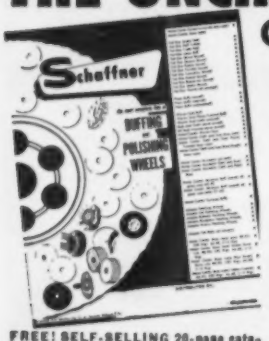
2 claims

No. 2,884,338—4/28/59—Oiling Tinplate—G. Jenison assignor to National Steel Corp., Delaware.

The use of electrostatic means to oil tinplate is described.

6 claims.

THE UNCHALLENGED LEADER IN THEIR FIELD



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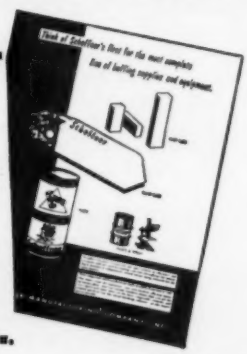

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UNPLATED STEEL BUMPER
(finished with 220 belt)
SAME BUMPER PLATED WITH:
2 mils of leveling Nickel Plating
0.01 mils of chromium plating

Reflections in this bumper section illustrate the rich, mirror-like finish you get with quality Nickel-chrome plating. A layer of leveling bright Nickel plating evened out the surface imperfections on the bare steel visible at left and provided a smooth foundation for the subsequent chrome plating.

How Inco promotes greater use of leveling Nickel plating

In an extensive advertising campaign to *your* customers, we are using two powerful arguments to promote greater use of leveling Nickel plating:

1. greater economy

2. better plating quality

Full-page advertisements in "Automotive Industries," "D.A.C. News," "Product Engineering," and "Industrial Design," will tell your customers that leveling Nickel plating reduces — even eliminates — polishing before plating and buffing afterwards.

Then these advertisements go on to say that when a second layer of Nickel is used over a semi-bright leveling coat, the duplex nickel coating that results offers beauty and durability *beyond compare!*

Promotional support like this is just one of the many ways we try to make your job easier and more profitable. Another is the way we are helping to assure continued ample supplies of Nickel for your quality finishes. (Inco's new $100-million mining development in Manitoba means that in 1961, the Free World will be able to produce more than twice as much Nickel as it consumed in 1958.)

You can plan with Nickel -- plan to raise plating quality and beauty, to make products more salable. And to help you do this — as part of our program to keep you posted on plating developments — Inco can send you a newly revised technical bulletin designed specifically for platers — "Practical Nickel Plating." Write us for your free copy.

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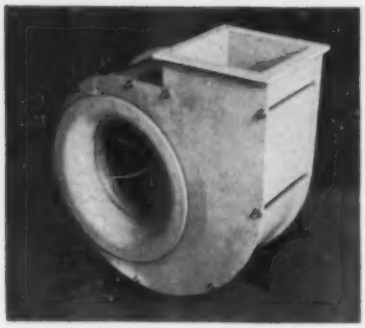
EQUIPMENT AND SUPPLIES



E—1101. PVC Fan—Heil Process Equipment Co. has manufactured a solid plastic fan to handle corrosive and poisonous fumes.

All parts of the Heil Rigivin fan coming in contact with the fumes, including the housing and wheel, are constructed entirely of solid, unplasticized polyvinyl chloride, and consequently are reportedly unaffected by the corrosive conditions. The fan is provided with heavy, oversize, outboard bearings and is designed to operate at well below its critical speed, assuring continuous, uninterrupted service life.

E—1102. Work Holding Process. A new work holding process, designed to cut preparation time and increase efficiency in the plating of small objects, has been introduced by Colorward Corp.

The new process, patented under the name Colorward, is expected to cut the plating costs of such objects as keys, jet blades and washers by as much as 50 per cent, according to its inventors.

It will be useful for platers and metal finishing companies working with products for which firm or rigid contact is required to provide sufficient electrical current.

Parts to be treated by the process are loaded and unloaded by means of an air-operated piston, mounted in line with holes or apertures of the parts, which forces a rod and a strip of spring metal through the holes.

Dimensions of both the strip and rod are pre-determined so that when the rod is forced through the holes of the parts an arc is formed laterally on the strip, resulting in a three-point contact on each part between the two sides of the strip and the radius of the rod.

E—1103. Filter Cartridge—American Felt Co. has announced the introduction of a new filter cartridge. The new line, utilizing new synthetic fibers in a uniquely constructed filter media, is said to assure true micron precision for particle filtration.

The filter cartridge AFCO is introducing consists of an aluminum core and viscose fiber "Feutron" filter media. The fiber disks are locked in place around the perforated core by end retaining rings and encased in stockinette for ease of handling. The edges of these disks are scalloped to give maximum filtering action and the scalloped design is the result of extensive tests to determine maximum efficiency and economy.

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E—1104. Emulsion Detergent—Heatbath Corp. introduces a new solvent emulsion detergent known as Pen Sol No. 2. This material has a dual purpose to clean and protect metal in one operation. It can be considered as a combination of an emulsion, rust-proofing oil and cleaner.

Normally, it is used 1 to 2 per cent with water at room temperature. It may be employed as a soak cleaner or in single or multiple stage washers. When used hot, it is said to be an excellent cleaning agent removing drawing compounds, shop soils, oils and metal chips.

Good cleaning, corrosion protection, easy removal, safety and economy are advantages claimed for this detergent.

E—1105. Nickel Brightener—A new nickel brightener, Nimax BN-30, is now being introduced by Federated Metals Division of American Smelting & Refining Co.

The brightener is a concentrated single addition agent, claimed to be specially formulated to yield brilliant barrel nickel deposits. Used in conjunction with BN-10 additive, it produces bright nickel deposits which are said to readily accept chromium plating.

The brightener is reported to have broad tolerance to variations in both solution concentration and current density.

E—1106. Miniature Selenium Diodes—Designed for volume applications where reliability, low cost and small size are key factors, new subminiature plastic-encapsulated selenium diodes have been developed by Radio Receptor Co. Inc., subsidiary of General Instrument Corp.

Capable of operating in ambient temperatures from 50 to 100C without derating, these diodes come in eight types, with peak inverse voltage ranges from 50 to 400 at 12.5 ma. Maximum case length is 0.380 inches for all eight types, with widths ranging from 0.340 in. for the 50 and 100 units up to 0.480 in. for the 400 type.

Protected from atmospheric conditions by the plastic encapsulation, the diodes are color coded for simple identification. Bent pigtail and red dot on body give positive lead indication.

E—1107. Polyethylene Drum—Development of a large size, molded polyethylene drum has been announced by the Redmanson Corp.

Applicable for electroplating operations, polyethylene is resistant to corrosion. Because of injection molding the walls are uniform in thickness; there are said to be no weak spots, no pinholes.

Besides its use for handling and storing of acids, these drums are being used as dipping tanks in a semi-automatic electroplating line.

The polyethylene container is light in weight and easy to handle. It may be easily cleaned and tightly sealed. These drums may be nested inside one another when they are empty, thereby reducing storage space requirements. Redmanson is producing them in various sizes up to 55-gal capacity.

E—1108. Generator Brush—Hanson-Van Winkle-Munning has announced a newly designed generator brush that makes possible the use of H-VW-M's Equaload brush feature by any generator user.

Previously this feature was available only to platers using H-VW-M power generation equipment.

A new and simple means of insulating each individual brush from the brushholder has been devised, making for equal brush wear and no threading of the commutator.

There's no waste water from a V-notch

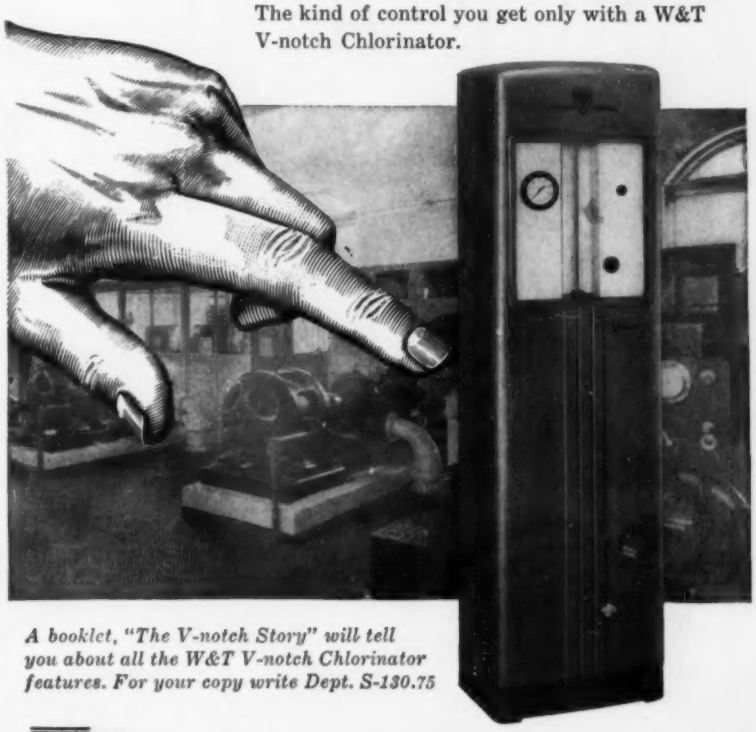
Why?

Because a V-notch Chlorinator needs no auxiliary water supply.

You can plan on clean, dry chlorinator rooms with no messy drain—no chlorine gassing back. And best of all... gone forever is the high cost of wasted auxiliary water.

And, of course, the right plastics make the whole chlorinator chlorine-proof.

Yet these are just added benefits to the main job: Simple, dependable, wide range chlorine control. The kind of control you get only with a W&T V-notch Chlorinator.



A booklet, "The V-notch Story" will tell you about all the W&T V-notch Chlorinator features. For your copy write Dept. S-130.75

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ARTICLE REFERENCES

By
WILLIAM TUCKER
Eastman Kodak
Rochester, N. Y.

Most of the articles listed here may be obtained by writing to the publications in which the articles were published. Addresses are given at the end of the references for the reader's convenience.

Photostat or microfilm copies of articles in available magazines may be obtained from: Library of Congress, Washington, D. C.; New York Public Library, New York; Engineering Societies' Library, New York, at prevailing rates. In other cases, consult Wilson's Union List of Serials at your nearest public library for other sources of these articles.

121. ANODIZING

a. *EQUIPMENT REQUIREMENTS FOR ANODIZING OPERATIONS.* Gilbert Tramer. Plating Management, September 1959, pp. 7-8, 19.

122. BLACK OXIDE COATING

a. *A BLACK OXIDE FINISH ON STEEL.* K. C. Srivastava. Electroplating (India), *1*, No. 2, June 1959, pp. 56-57.

123. BRIGHT DIPPING

a. *BULK BRIGHT DIPPING.* J. C. Brown. Metal Finishing, *57*, No. 9, September 1959, pp. 70–72, 79.

124. CONTROL

a. *TROUBLE-SHOOTING IN THE PLATING SHOP.* C. F. Corfe. Electroplating and Metal Finishing, *12*, No. 8, August 1959, pp. 291–295, 298.

b. *THE HOW AND WHY OF GAGING.* Richard L. McKee. Grinding and Finishing, *5*, No. 4 August 1959, pp. 20–23.

c. *GAGE BLOCKS: INDUSTRY'S LINKS TO PRECISION.* Richard L. McKee. Grinding and Finishing, *5*, No. 5, September 1959, pp. 46–50.

125. CORROSION

a. *SCREENING TESTS OF INHIBITORS TO PREVENT CHLORIDE STRESS CORROSION.* J. H. Phillips and W. J. Singley. Corrosion, *15*, No. 9, September 1959, pp. 18–22.

Corrosion
National Association of Corrosion Engineers
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No 1 Main St.
Houston 2, Texas

Electroplating and Metal Finishing
15 Udney Park Rd.
Teddington, Middlesex
England

Grinding and Finishing
Hitchcock Publications
Wheaton, Illinois

Metal Finishing
381 Broadway
Westwood, N. J.

Plating Management
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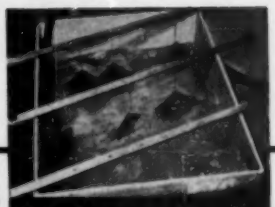

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Quite a few things. For example, there's the use of Becco Ammonium Persulfate in etching printed circuits. Seems the material works a lot better – at less cost – and with none of the hazards of the ferric chloride solutions conventionally used.

Then, there's the problem of pickling copper and brass. Lots of pickling agents will do this – only trouble is, you've got to paint or plate or do whatever you're going to do with the metal rather quickly. Or else. Or else it will tarnish or oxidize and you're in the pickle all over again.

Not so with Ammonium Persulfate. Cleans fine. Puts a mild etch on the surface, too, for better paint or plating bonding. More important, perhaps, is the fact that the metal resists retarnishing for up to two weeks. Ideas?

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No. 39 and 51—Surface Treatment of Metals with Peroxygen Compounds.

No. 86 – Improving Properties of Copper and Brass Surfaces.

No. 97 – Paddle Etching of Printed Circuits with Ammonium Persulfate.

No. 99 – Tank Immersion Etching of Printed Circuits with Ammonium Persulfate.

No. 102—Etching of Printed Circuits with Mercury Activated Persulfate.

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TRADE LITERATURE

L—1101. Rectifiers—Djeco division of Djordjevic Engineering Co. has issued a 16-page bulletin entitled "Rectifiers for Plating." Bulletin no. 100 describes various type of selenium, germanium and silicon rectifiers. Included are engineering specifications and illustrations of different types of dc power supplies with and without full automatic control of different ratings from 100 w to 500 kw.

L—1102. Abrasive Finishing—New data sheet from The Lea Manufacturing Co. covers the abrasive finishing of aluminum and magnesium and their alloys. Complete information on wheel heading, lubrication, speed and type of buff are included. The sheet covers such finishes as satin, matte, butler and bright. Instructions are applicable to such forms as castings, formings, extrusions, spinnings and stampings.

L—1103. Barrel Finishing—A seven-point system for scientifically controlled barrel finishing is detailed in "Carbotrol 7," a 36-page booklet just released by The Carborundum Co.

The booklet sets forth size and type of media, ratio of media to parts, load height, water, compounds, barrel speed and tumbling time.

A complete line of tumbling media, barrel finishing compounds and precision barrel finishing machines and equipment is listed for the full range of tumbling operations.

L—1104. Immersion Heating Boiler—Bulletin 5209-B illustrates and describes the low pressure models of Sellers immersion steam boilers. These models, for commercial and industrial space heating, are built to the same standards as the companion line of high pressure boilers widely used for industrial purposes. Range of sizes in the Model 15 Senior line is from 80 to 500 hp.

L—1105. Current Interrupter—Rapid Electric Co. has made available their bulletin CI-1 which provides an illustrated description complete with wirings and mechanical diagrams of their newly introduced current interrupter.

This model is designed for plating tank use where DC current interruption is required for various patented processes and solutions.

The many timing ranges available are listed in the brochure.

L—1106. Grinding and Polishing Units—A new illustrated, eight page, two color brochure (Form 59-1) describing Murray-Way Micro-Polish Units for grinding and polishing coils, blanks, and sheets in all materials is now available from Murray-Way Corp.

The booklet discusses features and advantages of the units and gives detailed engineering specifications. Photographs and descriptions of auxiliary equipment and the many variations and combinations are also included.

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3650	(*3.6–5.0 pH)	8610	(8.6–10.0 pH)
2439	(*2.4–3.9 pH)	10113	(10.1–11.3 pH)
1028	(1.0–2.8 pH)	11131	(11.0–13.1 pH)
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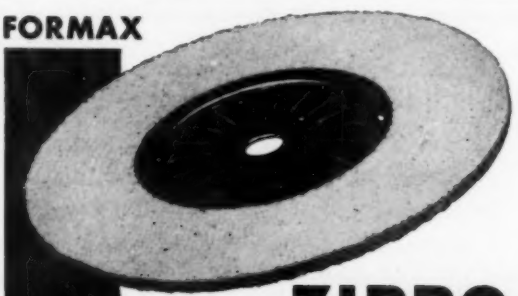

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PERSONALS

W. JOSEPH CLUFF, a veteran of many years in the plating and foundry industries, closed a career of service as a supplier to these fields when he retired as president of Frederic B. Stevens, Inc. He will continue as a consultant to Stevens and as a member of the board of directors of the Udylite Corporation.

Mr. Cluff started working for Stevens as a clerk in the bookkeeping department of an affiliated company. Twenty-five years ago he became president, succeeding Frederic B. Stevens, founder of the Detroit firm.

During his presidency of Stevens, the sales force increased more than 200 per cent and the company became widely known. During its 76 years of local and national service Frederic B. Stevens, Inc. has established its name as a manufacturer of electroplating equipment, polishing and buffing compositions.

Mr. Cluff will be succeeded by **CLYDE H. REEME,** president of the Udylite Corporation, of which Stevens is a subsidiary.

Mr. Cluff is a member of the Detroit Athletic Club, the Detroit Executives Association, the Detroit Rotary Club and holds a life membership in the Oakland Hills Country Club.

W. J. Cluff

F. P. DeLuca Jr.

FRANK P. DeLUCA JR. has been appointed executive vice president of Acoustica Associates, Inc. of Plainview, Long Island, N. Y. and Los Angeles, Calif. Mr. DeLuca, who is a director of the corporation, was formerly vice president and general manager of Acoustica's Western Division. **FRED C. MEHNER,** formerly with Hughes Tool Co., has been appointed general manager of the Western Division of Acoustica Associates, Inc., Los Angeles, Calif.

•

THOMAS NUGENT has been named technical sales representative for upper New York State for Heatbath Corporation. Mr. Nugent has had extensive experience in the heat treating and metal finishing field. He will have headquarters at 33 Mechanic Street, Jordan, N. Y.

BERNARD LINDSTROM, formerly our Technical Sales Representative in this area, has been transferred to the Eastern New England area where he will represent Heatbath in the same capacity. Mr. Lindstrom will have headquarters in Springfield, Mass.

B. Lindstrom

P. D. Harper

PAUL D. HARPER as West Coast district manager of its Chemical Division has been announced by Michigan Chrome and Chemical Company.

Mr. Harper is a graduate chemical engineer and has had 20 years of supervisory experience in the metal finishing industry. He was plant manager of Michigan Chrome's Plating and Coating Divisions for several years prior to moving to the West Coast as a representative for a leading precious metal solution manufacturer. His territory incorporates the three West Coast states plus Arizona.

•

GEORGE O. PFAFF has been appointed director of marketing at Wheelabrator Corporation.

In addition to his current function of supervising abrasive sales, he will be responsible for marketing Wheelabrator's general products and Techline Division equipment and supplies.

Mr. Pfaff attended the University of Notre Dame where he received a BS degree in chemical engineering and the University of Pennsylvania's Wharton School where he earned his Master's degree in business administration.

He began his association with Wheelabrator Corp. in 1953 in the Sales Promotion Department. Later he was made manager of standard equipment sales. In 1956 he organized and became the head of the Abrasive Sales Division.

F. H. Dayton

R. G. Marshall

FRANK H. DAYTON and **RICHARD G. MARSHALL** sales representatives of Hanson-Van Winkle-Munning Co. have been reassigned:

Mr. Dayton has been assigned from Dayton to the Chicago area. He joined the company in 1956, and holds a BA in chemistry from Bucknell University. He is an active member of the AES. The Chicago office is at 6121 North Elston Avenue.

Mr. Marshall has been with the company for more than six years. A member of the AES, he came to H-VW-M from the plating laboratory of a nationally known industrial firm. He is a graduate of Michigan State College, BS in chemistry. Mr. Marshall moves from Philadelphia to Dayton, where he will cover the western Ohio area.

HOWARD L. WRIGHT has been reappointed by Hanson-Van Winkle-Munning Co. as the company's sales representative in Philadelphia and Northeastern Pennsylvania, where he had represented the company for 12 years.

Mr. Wright has just completed a two-year market research assignment for H-V W-M.

He joined the firm in 1946 and is a graduate of Franklin and Marshall College.

•

ROBERT E. SAUTER has been appointed technical sales representative in southern Illinois and Missouri by Cowles Chemical Co. He will be headquartered in St. Louis. Mr. Sauter served with the Marine Corps and attended Regis University in Denver, Colorado and St. Louis University in St. Louis.

•

JOHN R. STROM has been appointed chemist and process engineer for Roto-Finish Co., Kalamazoo.

Mr. Strom, a Baldwin-Wallace graduate in 1951, brings considerable experience to his new post. He has served as process engineer for Brown-Lipe-Chapin Division of General Motors, and as plating superintendent for the Eljer Co., Marysville, Ohio.

At Roto-Finish, he will be in charge of new product development, and the development of new compounds.

J. R. Strom

D. G. Foulke

DR. D. GARDNER FOULKE, formerly manager electrochemical development with Hanson-Van Winkle-Munning Co., has joined Sel-Rex Corporation, Nutley, N. J. as research director, Precious Metals Division. Dr. Foulke will head up Sel-Rex's research team, with the goal of developing additional precious metals electroplating processes.

During the more than 17 years that he has been associated with the metal finishing industry, Dr. Foulke has held technical-executive positions with such firms as Republic Steel and Houdaille-Hershey Corp. As chief chemist for the latter company, he was assigned to the Manhattan Project from its inception. He has been a teacher at Rutgers University, Beaver College and Brooklyn Polytechnic Institute, a consultant with A. K. Graham & Associates and Foster D. Snell, Inc.; and has been active in professional societies—past executive secretary of the American Electroplaters' Society and managing editor of PLATING MAGAZINE, vice chairman of the AES Research Committee, and vice chairman of the Electrodeposition Division of the Electrochemical Society.

He holds 11 patents in the electroplating field (with four more pending), and has had 32 technical papers published by trade and professional publications.

•

JOHN R. McCULLOUGH, field salesman headquartered at the Diamond Alkali Company's Pittsburgh sales office, is named special staff assistant to the director of sales.

DAVID F. HAHLEN, a junior engineer in Diamond's soda products development group becomes an analyst in the market planning group of the general sales department—a newly-created position.

Mr. McCullough is a 20-year Diamond veteran who started with the company in Pittsburgh.

He attended Business Training College, Pittsburgh, in 1939 and then served four years in the U. S. Air Force.

Mr. Hahlen came to the Diamond organization in 1956. He is a graduate of Case Institute of Technology, Cleveland, where he earned his BS degree in chemical engineering in 1952.

•

JEROME L. HOCHENEDEL has been appointed assistant manager of the Houston, Texas sales branch of Solvay Process Division, Allied Chemical Corp.

E. KENNETH LEINS moves from the Division's Technical Service Department at Syracuse, N. Y. to its New Orleans, Louisiana sales branch. He has been assigned to the Baton Rouge sales territory.

A native of Baton Rouge, Mr. Hochenedel received a degree in chemical engineering from Louisiana State University. He joined Solvay in 1951 and since that time has been a salesman reporting to the New Orleans branch office and covering the Baton Rouge territory

Mr. Leins with Solvay for 10 years, was graduated from Cornell University with a Bachelor's degree in chemical engineering.

•

RICHARD C. SCOTT has been appointed as director of staff engineering by Dresser Electric Co., Detroit. His primary responsibility will be the development of new products and expansion of the present product lines which includes electroplating rectifiers.

Mr. Scott comes to Dresser after twenty years with The Udylite Corporation as chief electrical engineer. Prior to that, he was associated with Electric Storage Battery Co. following graduation from the University of Michigan as electrical engineer.

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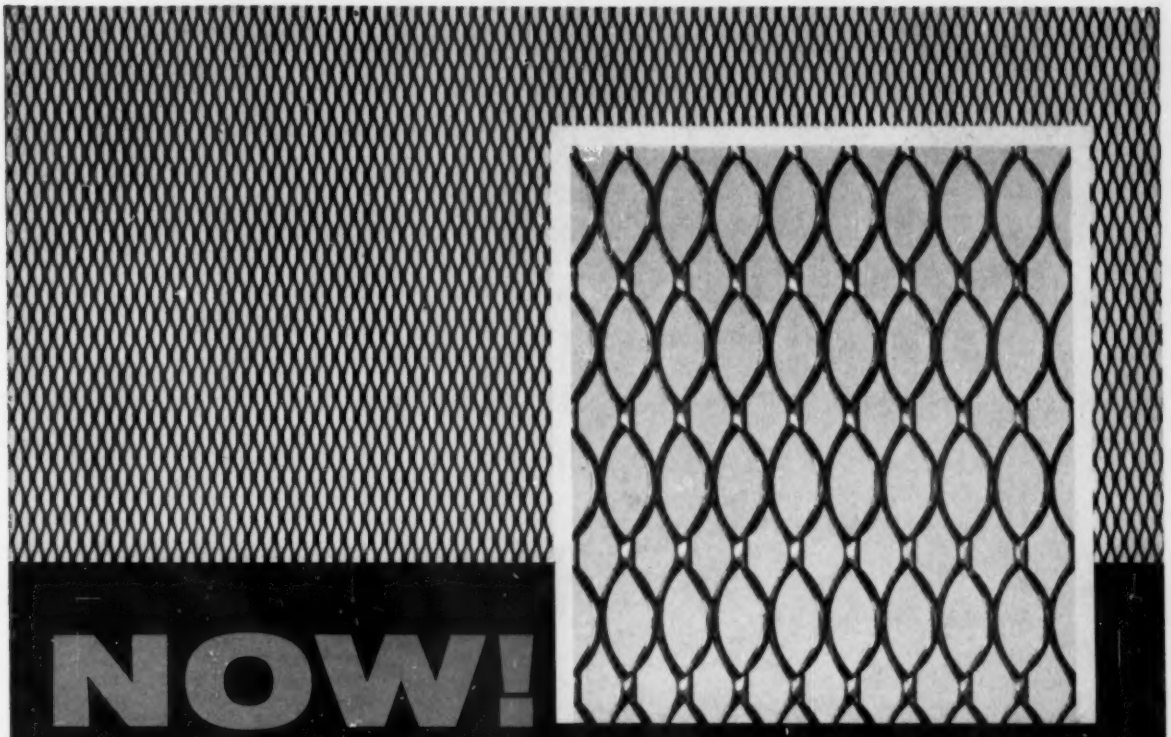

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Protective Coatings for Metals. 2nd edition by R. M. Burns and W. W. Bradley. 657 pages.	12.50	10.50
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Electrochemistry—Principles and Applications..... by E. C. Potter.	10.00	8.35
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Surface Treatment and Finishing of Aluminum and its Alloys..... by S. Wernick and R. Pinner	13.25	11.95
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Procedures for Analyzing Metal-Finishing Wastes. 102 pages.....	1.00	1.00
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Control in Electroplating—Symposium.... Institute of Metal Finishing, England. Papers by K. E. Langford, T. E. Such, C. F. Corfe and D. W. Smith. 92 pages.	2.50	2.00
Effect of Surface on the Behaviour of Metals Papers by G. L. J. Bailey, T. P. Hoar, F. T. Barwell and R. W. B. Stephens. 100 pages.	10.00	8.35
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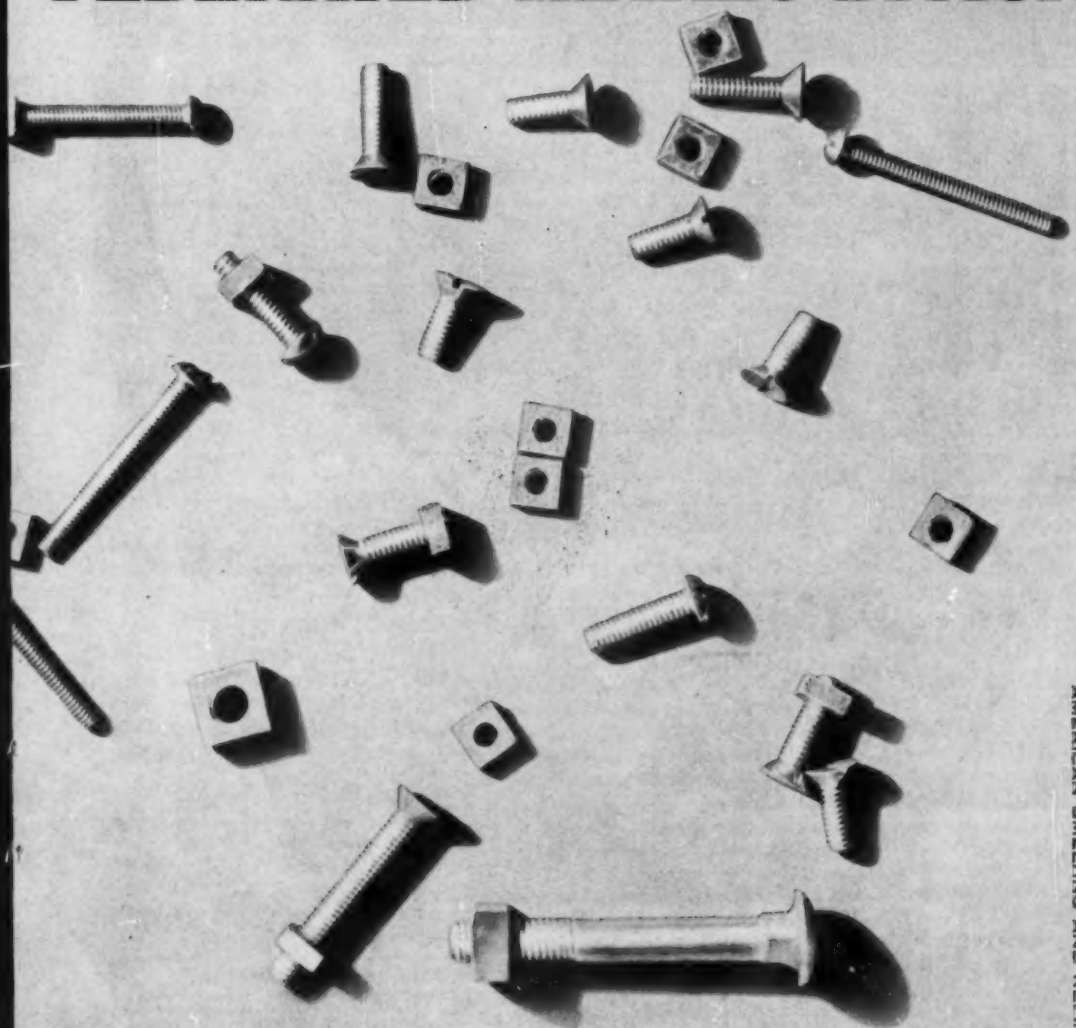

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BRANCH NEWS

Total AES Branches U. S., Canada, Australia, November 1, 1959—58.

Blue Ridge members visit Proctor Electric Co. L. to r, William Miller and Joseph Fowler, both Proctor Electric; Dan Barber, Newton Instrument; Dell Taylor, General Metals.

BLUE RIDGE
Branch Tours Proctor Electric Plant

The up-and-coming Blue Ridge Branch held its first meeting of the new season on Sept. 11, at the Blue-View Restaurant in Mount Airy, N. C.; 31 members and guest present, **Dr. Nelson F. Murphy** presiding. Attendance included members from Durham, Roanoke, Greensboro, Mt. Airy, Winston-Salem, Charlotte and Blacksburg.

A new Branch publication to be known as "The Branch News" was given official recognition and authority. The publication will be edited by the Branch secretary. After a brief hashing of Branch business the meeting was turned over to **William J. Miller Jr.**, of Proctor Electric Co. Mr. Miller introduced the officers of this booming Mt. Airy plant and conducted us through a full plant tour; from stamping, through electroplating, to real bread test-toasting.

Proctor is the largest manufacturer of electric toasters in the world.

This was the third Blue Ridge plant tour in recent months. The Branch has found wide membership satisfaction, and higher attendance on recent plant tours of General Electric of Roanoke, Bassick-Sack of Winston-Salem, and now Proctor Electric of Mt. Airy, consequently it is expected that more plant tours will follow.

Robert H. Probert
Secretary-Treasurer

BLUE RIDGE
Helbig on Carbon; Plans for Third Regional

The Blue Ridge Branch met on Oct. 2, at the Carlton Terrace Hotel in Roanoke, Virginia. **Dr. Nelson F. Murphy** presided.

Delegates for 1959–60 were announced as **T. R. Boggess, Bruce Wallace,** Dr. Nelson F. Murphy and as alternates **L. C. Jackson, H. R. Welfare,** and **Michael Milo.**

A new member was announced.

The speaker for the evening was **W. A. Helbig,** Marketing Division, Atlas Powder Co., who talked on "Purification of Plating Solutions by Activated Carbon Treatment."

The third Annual Dixie Regional Technical Session will be held February 3 and 4, 1961, at the Hotel Roanoke, Roanoke, Virginia.

Robert H. Probert
Secretary-Treasurer

BRIDGEPORT
LaVelle Discusses Aluminum and Zinc Die Castings

The regularly scheduled business meeting and educational session was held at the Hotel Barnum on Friday, Sept. 11. President **Al Ferguson** called the meeting to order. A few moments of silence were observed in memory of **Raymond Kwasnik** and **Mederick Brassard,** both recently deceased.

Reporting the Detroit Convention, **Richard Barrett,** Supreme Society delegate, stated that the new per capita tax was established after proposals for higher amounts had been defeated. All amendments to the constitution were passed. Hartford was selected as the locale for the 1961 Interim Meeting.

President Ferguson read a letter from *Products Finishing* concerning a prize contest to be held shortly wherein participants would submit a paper on Finishing Experiences and Techniques. **V. Consalvo** won the door prize.

Don LaVelle of American Smelting and Refining Co. spoke on "The Metallurgy and Production of Aluminum and Zinc Die Castings" and also discussed finishing problems. His talk was repeatedly interrupted, at his request, by questions from the floor. Mr. LaVelle received a rousing standing vote of thanks for his splendid, informative talk and demonstrations.

BRITISH COLUMBIA
Meeting Devoted to Branch Business

Twenty-seven members and guests attended the Sept. 24 meeting at the White Spot Dining Room. The Branch welcomed three new members and looks forward to happy associations with them.

A report on the forthcoming night school course was given by **T. Wallington.** Notices have been sent to candidates.

Due to the increase in per capita tax, it was moved by **J. Lee,** seconded by **C. Schlossareck** and carried, that the Executive's recommendation be adopted to make the 1959 dues $12.50 per member.

Appointed to represent the B. C. Branch for the present fiscal year are T. Wallington, **N. Shepherd, R. Wolloschuk,** delegates; and **W. Marquardt, J. Hurford, W. Kilby,** alternates.

A letter from headquarters in connection with the July 1960 issue of PLATING magazine was read in which it was asked whether this Branch would be interested in preparing and sponsoring a technical paper on suggested subjects.

Two short educational films were shown.

Doug. Armstrong
Secretary

BUFFALO
Lux Speaks on Metal Cleaning

The Buffalo Branch held its first meeting of the 1959–60 season Friday, Sept. 11, at the Niagara Manor in Buffalo, with 33 members and 6 guests in attendance.

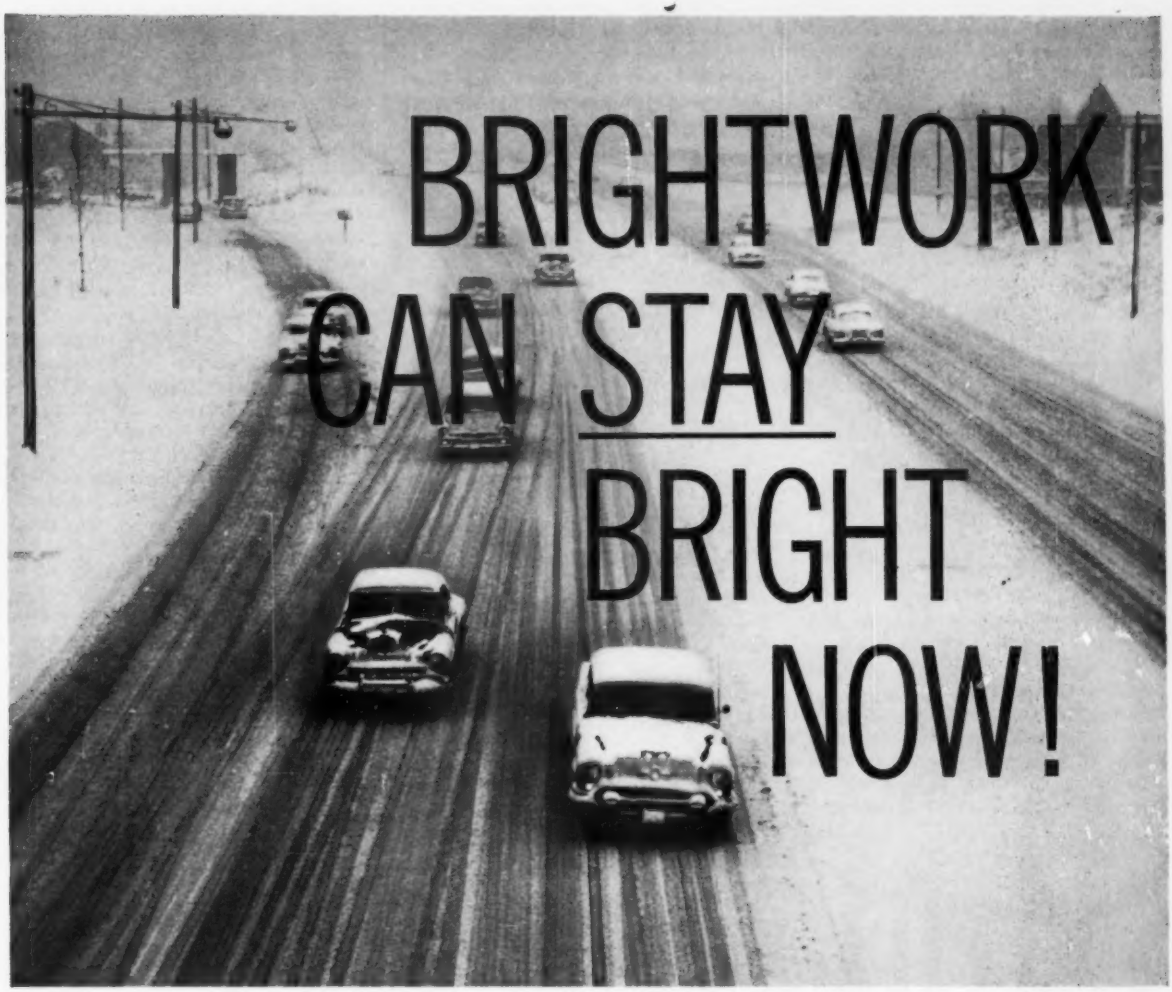
Four new members were elected.

Bert Kirchoff reported on happenings at the Business session of the Golden Jubilee Convention.

George Wolf and **Bob Eich** were appointed as delegates to the Technical Societies' Council of the Niagara Frontier.

BRANCH SECRETARIES

Branch News is required of all Secretaries monthly by AES Bylaws. First of the month is Branch News deadline for next PLATING issue. Any items on hand on that date will be carried in that edition. Later arrivals will appear in the issue immediately following. In reporting talks given by speakers before the Branch, please give titles of the talks, the speakers' full identification and any other pertinent information of interest to other Branches and PLATING's broad readership.



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The committee for the annual Christmas Party is **Roger Brown,** Chairman, **Fred Goeckel** and **Dick Piccoli.** The Christmas Party will be held in place of the regular meeting in December.

After the business session Bert Kirchoff introduced the speaker of the evening, **G. A. Lux** of Oakite Products, Inc. whose subject was "Some Fundamentals of Metal Cleaning." The talk was supplemented by several interesting demonstrations of basic cleaning applications.

The January meeting will be held Friday, January 8. **C. H. Sample** of the International Nickel Co. will talk on "Corrosion Behavior and Protection Value of Electrodeposited Coatings".

Robert E. Lienert
Secretary

CAPITOL DISTRICT
Doughty Discusses High Speed Plating

The September meeting of Capitol District Branch was held at the Hot Shoppes, Albany, N. Y. on Sept. 14th.

The meeting was called to order by President **Robert Hill.** During the meeting Mr. Hill appointed two committees. The Christmas Party committee consist of Chairman **Art Eisner** along with Ted Infield, Nick Callantone and Ed Raymond. Vice President **Zygamond Nash** was appointed chairman of the membership committee with **John Green, Walt Bentley, Merl Shaw, Don Dagnoli, Merl Gunnett** and **Chet Klimek,** also serving.

A new member was introduced.

After the meeting **Lewis Doughty** of Lea Ronal gave a very interesting and educational talk on "Modern Bright and High Speed Plating". **Don Gaines** of Lea Manufacturing also attended meeting with Mr. Doughty.

Ed. LeGere
Secretary

CHICAGO
Problems Solved that Turn Hair Gray

The September meeting of the Chicago Branch was held Friday, Sept. 11, at Stella's Restaurant, 3206 North Kostner Ave., Chicago. An overflow crowd of members attended the dinner and first technical session of the new year. **Ed Smith** reminded the members of the Golf-Outing at the Itasca Country Club on Friday, Sept. 25, 1959. **Paul Glab** announced that there will be an exhibit and educational session held at Rockford College in Rockford, Illinois, sponsored by the Midwest Regional Society Group. Every member should try to attend this noteworthy event on Saturday, Nov. 7. **Charles Geldzahler** read a letter from **Ezra A. Blount** about the contest *Products Finishing* is sponsoring for the electroplating industry. The details of this contest appeared in the August issue. **Joan Trumbour Wiarda** made a presentation of the "Old-Timers Key" to **Rudy Hazucha.** Rudy accepted the gold plated key with a great deal of sentiment and thanks. Three membership applications were turned over to the board of managers.

Simon Gary, librarian, introduced the speakers and the subject was "This One Turned My Hair Gray". The speakers were **R. Johnson,** Metal and Thermit; **D. Saporta,** Udylite Corporation; **L. Shustick,** Du Pont; **P. Stevens,** Sel-Rex; **E. Wild,** R. O. Hull and **D. Morris,** Hanson-Van Winkle-Munning. These service men are well known to the Chicago Branch. Roger Johnson told how a chromium tank became contaminated because platers were skipping the rinses with work coming from the nickel tank. Don Morris had a problem of a silver tank going bad after the lunch hour. He found that a worker was using the tank to clean out his soldering cup. Lou Shustik related how a copper tank became contaminated with lead because the filter was lined with lead. Ed. Wild was confronted with a problem of cadmium turning brown upon storage during the hot, summer months. Air drying the parts after brite dipping in the nitric dip and replacing the nitric acid with a bright chromate dip helped to solve the problem. After a question and answer period the speakers were given a rising vote of thanks.

Christopher Marzano
Publicity Chairman

CINCINNATI
Inspect New Waste Treatment Plant

The 1959–60 year was started with an inspection trip to the Metropolitan Cincinnati Mill Creek Sewage Works which will go into full operation in November. The $26,000,000 plant, the second of three planned for Cincinnati, will provide primary treatment for the sewage and industrial waste from the highly industrialized Mill Creek Valley. The plant is designed to handle 120,000,000 gallons per day in dry weather and up to 360,000,000 gallons of combined sewage and storm flow. The group proceeded to the Gateway Restaurant at the Union Terminal for dinner and a short business meeting.

A new member was elected and President **Stephenson** appointed himself, **Ed Roof** and **Ezra Blount** as delegates and **Bill Young, Les Helmich** and **Bob Miller** as alternates to the 1960 National Convention.

David L. Kaplan

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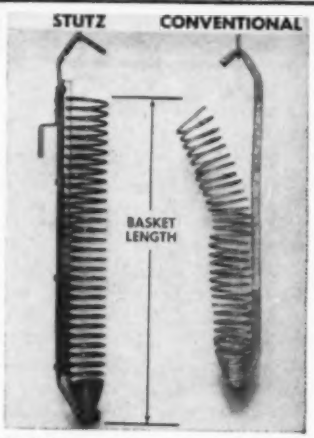

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COLUMBUS
Electrophoretic Coatings Discussed by Shyne

This regular meeting on Sept. 11 was called to order by President **Marvin Pingel.** Forty members and guests were present. Three candidates were duly approved and elected to membership.

In the business meeting, it was ruled that President Pingel would select a committee to consider nominations for Technical man of the year.

Librarian **Hugh Miller** introduced the speaker of the evening, **James J. Shyne** of Reaction Motors who spoke on "Electrophoretic Coatings." Mr. Shyne gave an interesting account of the theory and practice of the electrophoretic method of applying metal-metal oxide and cermet coatings to basis metals. He also described post-treatments including reduction and densification. A lively question period followed. Mr. Shyne also presented a fascinating film and commentary on Reaction Motors jet motor program which has provided the half-million horsepower motor for the X-15.

The meeting was adjourned, and refreshments were served through the courtesy of The Globe Chemical Company.

L. D. McGraw
Secretary

DALLAS-FT. WORTH
Bratton Speaks on Atlas Missile

The September meeting was held at The Crossroads Restaurant and Club on Tuesday, Sept. 22. The meeting was called to order by Branch President **M. E. Browning.** Guests were introduced, and there were 46 members and guests in attendance. Mr. Browning then asked Librarian **D. L. "Don" Allie** to give us a report on future presentations to our Branch, a schedule that is indicative of a most interesting 1960 season for our members and their guests. A question was put to the chair by **Carlos Gonzalez** with reference to the progress of the formation of the Southwest Regional Group, which was answered by Browning.

A brief outline was then given to the group about the forthcoming "Aerospace Finishing Symposium" to be held in Ft. Worth on Dec. 8 and 9, of which a goodly number of the local branch members are participating on various committees. The members of the Branch had the great pleasure of voting on the acceptance of four new members.

W. A. Bratton, project engineer, Astronautics Atlas Missile Team, presented a highly interesting and enlightening talk about The Atlas Missile Its Development, Functioning and Protective Finishes. The talk was augmented with a recently released film by the Air Force titled "On Target", that showed the preparations and launching of the missile. A hearty vote of thanks was extended to Mr. Bratton for his presentation.

T. E. Betz
Recording Secretary

DENVER
Rinker Presents Precious Metal Plating; Permanent Charter

After a vacation for the summer months, since June 5, the Sept. 11 meeting of the Denver Branch was held at the Oxford Hotel.

The meeting was chairmanned by the President **Bob Martin.**

Nine visitors were introduced.

Jim Jenkins was appointed to the board of managers.

Attention was called to the fact that the Denver Branch was listed in current issue of PLATING.

Mr. Martin read a letter from **John P. Nichols** saying our permanent charter had been granted and that he and President **Wysong** would be in Denver Oct. 13 for the installation of the Denver Branch Officers.

The meeting was turned over to **Harvey Schoonover,** who introduced **E. S. Rinker,** our speaker for the evening.

Mr. Rinker is the technical director of the Sel-Rex Corp. He spoke on Precious Metal Plating and illustrated his talk with slides and actual plated samples.

Philip L. London
Secretary

DETROIT
Lovell Speaks on Dual Chrome

The fall season of meetings got off to a rousing start on Friday, Sept. 11. More than 200 members gathered in the Wayne Room of the Statler-Hilton Hotel to hear **W. E. Lovell** speak on the timely subject of "Dual Chrome Plating of Cold Rolled Steel for Automotive Hardware."

Mr. Lovell, who has spent many years with the Ternstedt Division of the General Motors Corp., discussed the theory of the corrosion resistance of the dual chrome process. He illustrated his interesting dissertation with a series of slide films.

Immediately prior to the general meeting, the regular monthly meeting of the Detroit Branch Executive Group and Committee Chairmen was held. This meeting was presided over by **Donald M. Bigge** and attended by **E. J. Kubis, V. Cassidy, Manuel Ben, J. F. Siefen, J. D. Thomas, H. E. Head, L. M. Morse, W. Wilson, H. J. McAleer, C. DeGroat, W. G. Anderson** and **G. A. Cummings.**

The next Detroit Branch meeting will be held on Tuesday, Oct. 6 instead of the normal meeting date of Friday, Oct. 2. This will be a joint meeting with the Society of Die Casting Engineers, Inc., Detroit-Saginaw Valley Chapter. The

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speaker will be **W. H. Safranek** of the Battelle Memorial Institute, Columbus, Ohio. His subject will be "Factors Affecting Quality of Electroplated Zinc Die Castings."

W. G. Anderson

HARTFORD

Gurski on Plating Automotive Parts

The regular Branch meeting was held at the Veterans of Foreign Wars building on Sept. 21 and 44 members and guests were present. Preceding the meeting a movie in color was shown entitled "Finishes for Aluminum."

The guest speaker for the evening was **Joseph Gurski** of the Ford Motor Co., whose subject was "Plating Applications to Automotive Parts."

Various plated coatings are selected for the usefulness that they will serve: as zinc and cadmium for corrosion resistance, anodized layers on aluminum and chromium on piston parts for resistance to wear, decorative chromium with copper and nickel underneath, to prevent scouring and galling tin and copper are used on steel, for soldering and brazing parts are plated with tin for ease of soldering, copper is plated for stop off in carburizing and tin or bronze or nickel as stop off for nitriding. Specifications for most auto dealers are the same. Various testing methods are employed as visual, adhesion, salt spray, thickness, Corrodkote, drop tests, Magne-Gage, microscopic, acetic acid corrosion test. Factors affecting the quality of the plate are processing methods, design, plating thickness and poor cleaning techniques.

The technical chairman for the evening was **Arnold Johnson.**

Stanley Platoz
Secretary

INDIANAPOLIS

Clough Speaks on Vacuum Metallizing

The Indianapolis Branch started off the 1959–60 season with much interest and enthusiasm when we met on Tuesday, Sept. 1, at the Construction League, 1456 N. Delaware Street with 42 present for the dinner and 53 for the meeting. **Phillip J. Clough,** National Research Corp. spoke on "Vacuum Metallizing for Corrosion Protection." He told of preparing various surfaces for the finish, coating on plastics, compared with other finishes, and costs. Two popular metals used for vacuum metallizing are cadmium and aluminum and these require a post treatment after the coating. He told of corrosion resistance tests of 96 hr and how the coating has been accepted by the air force. This type coating can be deposited on parts that are usually difficult to electroplate and give a uniform finish. This might include bolts, etc. and he had several samples to show. Aluminum coating can be deposited on steel at a price comparable to chrome on steel. Many slides were shown during the talk and several questions were asked at the end by members. This was certainly a very worthwhile subject to present to our group.

The business meeting was called to order by the new president, **Les Reynolds.** First order of business was the presentation of a past-president's pin to **John Hood,** last year's president. **Ed Bruck** was asked by the president to make this presentation.

The president appointed **Quentin Shockley** as parliamentarian for the meetings.

John Holland explained the matter of the per capita tax. He made a motion to increase the Indianapolis Branch dues to $11. This was seconded by **Jack Hensley** and was passed. It was recommended that the Branch pay the additional $1.80 for this year rather than tax each individual.

One application for membership was read. **Ed Bruck** moved that this be accepted, seconded by **Abe Max** and carried. As our Branch intends to follow the national bylaws, future membership applications will be investigated for 30 days before voting.

The secretary read a letter from *Products Finishing* about the contest for people who work behind those plating tanks. Serious thought will be given to this opportunity by the members.

Abe Max suggested that all of the larger plants have a notice put on their bulletin boards announcing each monthly meeting of our branch. It would be up to the secretary to send it in to a member who is employed by these plants. Also, since Dr. Max is on the editorial board of PLATING he asked that each member pay close attention to the magazine and give any suggestions as to what type of articles are wanted, etc. PLATING wants to meet the needs of the members.

A letter was read from the publicity chairman of the Tri-State meeting which will be held in Cincinnati on April 23, 1960.

Our next meeting will be at Columbus, Indiana on Oct. 6 in the Central Park Cafeteria. The program is to be a surprise as usual! This will be Ladies' Night, too.

Quentin Shockley spoke of the Scientific Achievement Award. Names have to be in by Oct. 15. He thinks more members should be interested in competing for this as it is for all and not just the top people of the Society.

Edna Rohrabaugh
Secretary

LOS ANGELES
Saltonstall Tells of Agitation in Plating

The Apr. 8 meeting opened by President **Norm McEwan.** Visitors were introduced by librarian, **Bill Heinecke.**

Two applicants were installed into membership by President McEwan.

Dave Seymour reported progress for the "Handbook".

George Hetz reported for the 1960 convention committee. Progress was reported as very satisfactory.

Earl Coffin thanked the past officers, and the new slate was installed. Past President McEwan was presented with a transistor radio.

Marge Farmer, the new librarian, introduced **Dr. R. B. Saltonstall,** who spoke on the roll of Agitation in Plating.

H. K. Hunt
Secretary

LOS ANGELES
Weekly and Krentel Explain Phosphate Coating

The May 13 meeting was opened by President **George Hetz.** National Past President **Francis T. Eddy** was among visitors introduced by Librarian **Clare Ver West.**

Two men were initiated to membership.

President Hetz appointed **Oscar Grisat** as the new Research Chairman and reported for the 1960 Convention Committee.

Ged Magurean presented Past President McEwan with a Past President's pin.

Our librarian, **Marge Farmer,** introduced **Claude Weekly** and **Stuart Krentel,** who spoke on phosphate coating procedures.

H. K. Hunt
Secretary

LOS ANGELES
Zielberger Is Speaker; Hetz Reports on Convention Plans

The meeting of June 10 opened by President **Hetz.**

Guests were introduced by Sergeant-of-Arms, **Clare Ver West.**

Two new members were initiated.

George Hetz reported on the 1960 convention meeting of the entire committee after the Detroit Convention.

Dues are $15 per year, starting July 1, 1959, increased from $9.

Ernest Zielberger, the speaker of the evening, was introduced by the secretary in the absence of the librarian.

H. K. Hunt
Secretary

MONTREAL
Vacuum Metallizing Discussed by Walters

The Montreal Branch held its first meeting of the 1959–60 year on Sept. 14. at the Sheraton Mount Royal Hotel. The season started with a bang as an excellent number of members turned out to hear **F. Y. Walters** of the F. J. Stokes Co. of Canada give a very interesting and enlightening talk on Vacuum Metallizing. Mr. Walters was thanked on behalf of the Montreal Branch by **B. B. Millward.**

Applications of two new members were received and approved.

G. R. Davidson will chair a publications committee for papers from the Montreal Branch for publication consideration by PLATING MAGAZINE.

R. W. Niggemann
Secretary

NEWARK
First Metropolitan Regional Meeting

The first AES Metropolitan Regional meeting was held on Sept 25 at the Statler-Hilton Hotel in New York City with 200 in attendance.

New York Branch President **Joseph Rembecki** welcomed the members and introduced National First Vice President **W. Andrew Wesley.** Librarian **Martin Pollack** introduced Newark Branch Librarian **Al Korbelak,** who in turn announced that the first Louis Donroe Award for the best Timely Topic presented during 1958–1959 by a Newark member has been awarded to **James Shyne.** The presentation of the medal and cash prize was very graciously made by Mrs Frances Donroe.

Dr. Edward B. Saubestre, Enthone, Inc. and **August Mendizza** of Bell Telephone Laboratories presented papers.

After a spirited question-and-answer period, the 200 New York and Newark members and guests enjoyed a very pleasant social hour while consuming the plentiful supply of refreshments supplied by the New York Branch.

The first Metropolitan Regional Educational Meeting was indeed a success!

D. Gardner Foulke
Secretary

NEW YORK
Educational Session of Metropolitan Regional

The season was opened on Sept. 25 at the Hotel Statler with the Metropolitan Regional Educational Session by the Newark and New York Branches. Judging by the huge turn out of members from both Branches we can look forward to a very good season.

President **Rembecki** introduced **Dr. W. Andrew Wesley,** first vice president of the National Society and all the officers of the Newark and New York Branches.

All business was dispensed with.

Martin Pollack introduced the speakers of the evening, Dr. Edward Saubestre of Enthone Inc. and **A. Mendizza** of the Bell Telephone Laboratories.

Both speakers received a rousing round of applause after which the members put all their concentration on a buffet and foamy refreshment.

Fred Saras
Recording Secretary

WHY GUESS ?

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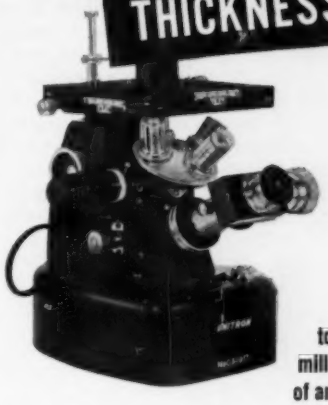

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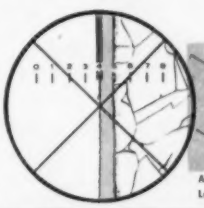

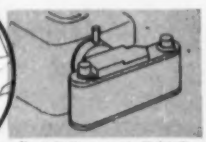

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PHILADELPHIA
Frank Describes Corrosion Testing of the 1959-60 season

The first regular meeting of the 1959-60 season was held on Sept. 28 at the Engineers' Club with 45 at dinner and about 100 at the meeting. Branch President **James Cogan** opened the meeting at 8:20, followed by First Vice President **Edward Hoffmann's** introduction of guests, after which each member arose and introduced himself. The secretary read the minutes of the last regular meeting of May 25 and the three meetings of officers held during the summer. Mr. Hoffmann announced that 27 members had not paid their 1959/60 dues and would be suspended if payment were not received by Sept. 29.

Mr. Cogan announced the appointments of the following chairman of standing committees: Editor of the "Reminder"—**Walter W. Gleadall;** Welfare, **Vincent L. Casswell;** AES Research Finance—**Raymond E. Morris;** Annual Educational Session and Banquet (Branch 50th Jubilee)—James E. Cogan Jr.

One new active member was admitted and three membership applications were received and turned over to the board of managers.

Librarian **Joseph Berenato** introduced **Allen M. Frank,** Frankford Arsenal, who spoke on "Accelerated Corrosion Testing." Mr. Frank described with slides the original work being done at the Arsenal on determining the effects of the variables encountered in the accelerated corrosion tests used to determine quickly the performance of products in corrosive environments. Covered were the collection rate, cabinet design, atomizing nozzle peculiarities, temperature, venting, purity of salt, concentration of salt solution, pressure and temperature.

I. Wm. Marcovitch
Secretary

PHOENIX
Nickel Plating Presented by Bosl

After the customary social hour, the September meeting at the Rons Club was called to order at 8:45 by President **Bill Griff.** Twenty-three members and guests were present.

President Griff announced that Jack Alpert, prominent local attorney and lifetime member of the Rons club will be considered an honorary member of the Phoenix Branch for his legal help, and requirement that we have a member of the Rons Club.

All present were urged to cooperate to make our installation meeting, to be held at the Valley Ho, Scottsdale, Friday, Oct. 9, 1959 a hugh success.

Robert Hays was appointed Sergeant-at-Arms. Committee chairmen were announced: **Floyd Huhn,** membership; **Paul Wible,** publications; **Dean Hill,** publicity; **Robert Axsom,** programs; **Paul Madden,** bylaws.

James Weaver read a letter from **Myron Browning,** president of the Dallas-Ft. Worth Branch, inviting us to attend the Aerospace Finishing Symposium to be held Dec. 7, 8 and 9.

Paul Wible, librarian, announced the list of speakers for this year and introduced our speaker, **Gene Bosl,** of the Hanson-Van Winkle-Munning Company. Gene gave us an entertaining and informative talk on "Practical Nickel Plating." Particularly his discourse on sulfamate nickel was welcomed by the audience.

James E. Weaver
Secrearyt

PROVIDENCE-ATTLEBORO
Lux on Metal Cleaning; Delegates Reelected

The first meeting of this season was held Sept. 21, in the Providence Engineering Society Building on Angell Street.

President **Ferguson** presided. **Gerry Noonan** was appointed chairman of the Christmas Party.

The incumbent delegates, H. L. Ferguson; **Pierre Lonsbury** and **Edward A.**

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Parker, and the alternates, **S. Kershaw; H. Lefebvre** and **Dan Turner** were re-elected for the new year.

Gerald Lux of Oakite Products discussed quite thoroughly and to the point "Some Fundamentals of Cleaning." More of these discussions on fundamentals are needed.

Edward A. Parker
Secretary

ROCHESTER
Blum Electroplating Course Proposed For Members

The first meeting of the 1959–60 season of the Rochester, N. Y. Branch was held at the German Club on Monday, Sept. 14.

A smorgasbord, attended by 31 members and guests, preceded the business meeting. President **Anthony J. Cottrone** presided at the meeting.

The generous acceptance by the Rochester area suppliers' representatives to sponsor individually the refreshments following each monthly meeting was announced.

Frank Beuckman presented the details of the proposed Metals Engineering Institute Course on Electroplating by Dr. William Blum to be given jointly to members of the Rochester Branch of the AES and members of the ASM. The proposed venture was received with a considerable degree of enthusiasm by those present.

An invitation was extended by the Syracuse Branch to the members of the Empire State group to attend their meeting at the Geneva Country Club on Sept. 21.

Announcement was made of a bowling party to be held for members and their wives on Oct. 10.

Barrie M. Gardner
Secretary

SEATTLE-PUGET SOUND
Rinker Talks on Plating of Precious Metals

The September meeting was held on Sept. 15, at Andy's Diner, 2963 4th Avenue South, Seattle, Washington.

A short business meeting which included election of officers was held and then the speaker of the evening was introduced.

E. C. Rinker of the Sel-Rex Corporation gave an interesting discussion on the various advantages and characteristics of rhodium, platinum and gold plating.

A good many members had questions on the various processes which Mr. Rinker discussed, and so a lively question-and-answer period followed the talk.

Helen Archibald
Secretary

SOUTHERN TIER
Swift Speaks on Metallurgy for Platers

The Sept. 15 meeting of the Southern Tier AES was held at Pierce's Restaurant, Elmira N. Y.

Our new branch president, **Charles Emery,** opened the meeting with greetings to the regular members, new members and guests. **B. Englebe** from Waverly, N. Y. and **Walter Sittmann** of Oakite Products Inc. were both guests at the meeting.

Many thanks were extended to members **Bruce Wells** and **Bob Ingram** for the fine job they did in their capacity of co-chairman of the annual Branch summer picnic.

Librarian **Holger Andreason** introduced **John Swift** of Swift Chemical Co. as the speaker.

Mr. Swift spoke on "What Every Plater Should Know About Metallurgy of Steel and How These Factors May Affect Plating." With the use of slides, he described briefly the production of steel, also the structures of steel during manufacture and hot rolling. Defects in steel were also shown during hot and cold rolling of steel. Summing up Mr. Swift stated that steel is a complex material which goes through many operations before it gets to the plating room.

Meeting adjourned at 10:30 P M.

Bill Rossiter
Secretary

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SPRINGFIELD

Strow Talks on Stripping of Electroplates

The Springfield Branch opened the 1959–1960 season with a combined special meeting and technical session held at Blake's Restaurant and President **Elery C. Gibson** started things rolling in high gear, because of the full schedule.

The Branch secretary made an announcement concerning the availability of extra copies of "Milestones of AES," explained *Products Finishing* magazine, the contest sponsored by Ezra Blount's "What Electroplating Has Done for Me."

The following delegates were chosen: **Robert J. Girard, Edward F. Koetsch Jr.** and **John E. Costigan**; alternates are: Elery C. Gibson, **Charles F. Griffin Jr.** and **Henry L. Heissfeld.**

The final item of the agenda was the change in the dues structure at the Branch level. Robert Girard presented a letter, which was read by **Alexander R. Salmond.** This letter, in its entirety, is included in the secretary's minutes of the meeting. Items of interest included the fact that through proper management, Springfield had not had any dues increase since 1946. Springfield has successfully operated in the black since then, and expects to continue. And now that Springfield is being forced to raise its dues, the increase is being held to a minimum. After discussion, a motion was made by **Edward R. Dupuis** to raise the dues $2 yearly, bringing the new figure to $11. This motion was seconded and met with full approval in the vote that followed. With the increase, Springfield is proud to feel that we still have the lowest dues structure in the North American continent, and give our members the most for that amount. Any competition?

Springfield also appreciates the editorial comment by Manuel Ben in the September PLATING magazine, and this, too, shows the status of the Branch at the national level.

Technical Chairman Edward R. Dupuis introduced **Henry A. Strow,** president of True Brite Chemical Products Co. of Oakville, Conn. Mr. Strow presented a very interesting and timely subject, "The Latest Development in Stripping". All the basic metals were discussed, and all the electroplates to be stripped. Several types of formulae for each, were given. The questions that followed proved the interest and importance of this phase of the metal finishing programs. It was considered very educational.

And as usual, the stay-at-homes didn't learn a thing.

Henry L. Heissfeld
Secretary

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WATERBURY

Fire Safety Presented by Wyckoff

The first meeting of the current season occurred on Sept. 10 at the Roger Smith Elton Hotel. President **Frank Tirendi** called the meeting to order. The chairman of the nominating committee, **Ted Voyda,** brought in the slate of delegates and alternates to the National Convention. **Perry Sloane,** Frank Tirendi and **William Giesker** for delegates and for alternates, **William Innes, Earl Couch** and **Frank Schneiders.**

Technical Chairman **Spencer Henn** introduced the speaker, **Charles Wyckoff.** Mr. Wyckoff's topic "Stop Them Before They Start" was of particular interest to the members present. He discussed the cause and effects of fires in industries both by lecture and by the showing of a film which pictured many of the hazards of which we are unaware. The discussion lasted late into the evening.

Francis A. Schneiders
Publicity

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AES MEMBERSHIP REPORT

ELECTIONS

Allentown-Reading: H. H. Francisco, R. J. Gollatz, R. W. Steinmetz
Boston: N. C. Annis, T. F. Boylan, A. Corrado, E. P. Creeden, H. F. Donald, A. Fletcher, W. Henry, J. J. Houlihan, J. B. Romolo, G. H. Weiner, E. D. Yamartino
Buffalo: C. E. Church, N. G. Hornung, R. L. Johnson, A. Mangine, G. C. Wolf
Columbus: M. Fulmer, C. C. Horning, R. H. Ward
Denver: E. D. Quinnell, J. W. Reed, S. Schjelderup, T. W. Stark
Detroit: D. B. Berry, J. J. Brazil, W. H. Davis, A. J. Emmerich, R. H. Harbin, J. J. Kary, J. D. MacDonnell, R. R. McGaw R. E. Roberts, R. A. Roda, P. L. Sadow, E. Sheridan, D. M. Stearns, B. A. Tye, H. G. Wissman, J. E. Zane
Grand Rapids: J. H. Cornelius, J. R. Kuiper
Miami: G. E. May, D. Schwartzberg, J. Vairetta
Montreal: J. L. Guyot, L. G. Johnson
Newark: A. I. Miller, G. A. Nelson C. J. Puleo, J. Rivera, J. Upton
New Haven: J. J. Kuzminski, J. Zuryk
Philadelphia: R. L. Rice
Phoenix: L. Cline, O. Espinosa, N. B. Johnson, S. Lewin, G. J. Reich
Providence-Attleboro: J. A. Powers, F. K. Smith
Rockford: G. A. Boles, E. E. Raske
Saginaw Valley: D. J. Bazzett, R. F. Cernick
Seattle-Puget Sound: C. W. Dutcher
Member-at-Large: P. R. Dickinson, Memphis, Tenn.; T. E. Dickinson, Liverpool, England; F. E. Firth, North Quincy, Mass.; P. Egre, Versailles, France; H. J. Wesolowski, Milton, Mass.

REINSTATEMENTS

Allentown-Reading: C. Schaad
Blue Ridge: H. R. Weaver
Boston: E. G. Judkins, R. T. Marshall, P. Marshall
Chicago: D. Arendt, A. Comyn
Detroit: J. D. Patrick
Miami: J. A. Faulk, W. W. Smith
San Francisco: E. R. Dodge

TRANSFERS

Blue-Ridge: G. Lordi from Syracuse, R. G. Tuttle from Southeastern
Bridgeport: E. Gessman to New Haven, R. Richards to Philadelphia
Buffalo: W. D. Hart to San Francisco
Chicago: P. Kaftol out, R. E. Scheel out
Cincinnati: H. Landsman from Bridgeport
Cleveland: J. R. Haines from Pittsburgh
Dayton: R. G. Counselman from Detroit, S. C. Putzan to Miami
Detroit: R. G. Couselman to Dayton, W. R. Fassnacht to Saginaw Valley, W. B. Gertz to Milwaukee, S. E. Lekander from Louisville
Miami: J. Linn from Southeastern, S. C. Putzan from Dayton
Newark: E. Archer to Allentown-Reading
Philadelphia: E. J. Baldwin from Southeastern, R. Richards from Bridgeport
Providence-Attleboro: F. Boothroyd to Waterbury
Southeastern: E. J. Baldwin to Philadelphia
Member-at-Large: R. L. Buckley from Twin City, K. D. Christians from San Antonio, R. C. Cripe from San Antonio, F. J. Kaim from Twin City

RESIGNATIONS

Bridgeport: M. Shipley
Buffalo: C. O. Block, H. E. Galvin
Chicago: L. J. Kocour, J. Manderscheid, R. Meyers, G. Unverzagt
Cleveland: C. C. Allen, L. E. Detre, J. T. Irwin
Dallas-Fort Worth: S. Witkoff
Dayton: E. B. Jones, C. Morgan
Detroit: H. M. Cherry, C. Schwall
Louisville: R. Groom, M. Matthews, R. Shallcross
Montreal: M. Baillargeon, D. McMullen, G. W. Wagner
Providence-Attleboro: E. Whitman, A. Winsor
Saginaw-Valley: R. O. Henson
San Francisco: F. DeMartini, B. Weinstein, F. E. Weston
Southeastern: J. W. Morgan, J. C. Rowan
Springfield: N. F. Plank
Waterbury: C. M. Nininger
Member-at-Large: J. E. Garssen, Vorden, Netherlands

SUSPENSIONS

Boston: W. F. Acks, J. L. Albertini, H. W. Cobb, J. F. Flores, R. I. Furbush, N. Georgoulis, J. R. Hughes, I. A. Lee, W. W. Sinclair, H. M. Smith, P. Sutherland, S. H. Swift
Bridgeport: A. Tetu, H. Zingo
Buffalo: R. B. Watson
Los Angeles: J. Abramson, M. Barsoom, F. J. Bunker, G. S. Dufour, D. Friedland, S. A. Golnick, J. H. Lavoy, R. M. Statzmen, C. E. Tackels, N. G. Wallace, C. F. Wentworth, B. W. Wombacher, W. J. Wood
New Haven: J. W. Beaver, R. Ehrsam, M. Ismailoff, E. R. Jackson, L. E. LaMotte, M. W. Macek, V. J. Perry, A. Ribas, J. Zibluk
Philadelphia: C. E. Atkinson, W. Beckhardt, R. E. Bone, H. Brown, G. H. Cook, T. J. Grindler, T. J. Grindler III, H. Jaffee, E. S. Jones, V. L. LaTrechiano, P. J. Lestician, H. Long Jr., H. A. Miller, P. Persemperi, R. J. Radomski, J. R. Raymond, I. Shapiro, E. G. Smith, T. J. Vezzosi, E. A. Walter, J. Weizer, I. W. Wilenchik
Providence-Attleboro: T. A. Babin, A. J. Boutin, J. H. Brin, P. Gyrsting, P. Hart
Southeastern: P. F. Gentry

DEATHS

Bridgeport: R. Kwasnik
Chicago: W. Barron, H. Weiland
Newark: M. Trevhaft
Saginaw Valley: J. Littell

BRANCH DIRECTORY CHANGES

ALLENTOWN-READING
Secretary-Treas: John B. Ernst
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Easton, Pa.

CAPITOL DISTRICT
Secretary: Mr. Edward Q. LeGere,
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Scotia, New York

CHICAGO
Meeting Place: Stella's Restaurant, 3206 N. Kostner Ave., Chicago, Ill.
Day of Month: 2nd Friday of each month
Time: 6:15 P.M.

DENVER
Secretary: Philip London
3160 Dover Drive
Boulder, Colorado

NEW HAVEN
Meeting Place: New Haven Motor Inn, New Haven, Conn.

PORTLAND
Meeting Place: Various
Day of Month: To Accommodate Speaker
Time: 6:30 P.M.

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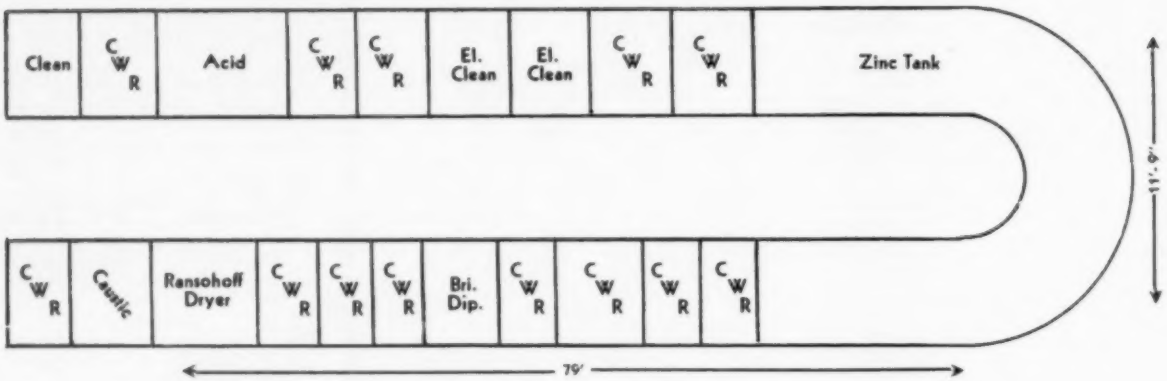

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FUTURE MEETINGS

AMERICAN ELECTROPLATERS' SOCIETY

December 4, 1959—**Detroit Branch,** Annual Meeting —National Officers Night—Symposium on Nickel Plating, Statler-Hilton Hotel, Detroit, Mich.

December 8-9, 1959—**Dallas-Fort Worth Branch,** co-sponsored with the Southwest Society of Aircraft Materials and Process Engineers, Symposium on "Treatments and Finishes for Aerospace Materials," Hotel Texas, Fort Worth, Texas.

December 12, 1959—**Newark Branch,** Annual Christmas Party, Hotel Robert Treat, Newark, N. J.

January 15-16, 1960—**Second Annual Dixie Regional Technical Session,** Saxony Hotel, Miami Beach, Florida. Sponsored by Miami Branch with Blue Ridge and Southeastern participating.

January 23, 1960—**Grand Rapids Branch,** Annual Educational Session and Dinner Dance, Pantlind Hotel, Grand Rapids Mich.

January 29, 1960—**Editorial Board Meeting,** Conrad Hilton Hotel, Chicago, Ill.

January 30, 1960—**Chicago Branch,** Annual Meeting and Banquet, Conrad Hilton Hotel, Chicago, Ill.

February 18, 1960—**Research Committee Meeting,** Ben Franklin Hotel, Philadelphia, Pa.

February 19-20, 1960—**Seventh Interim Meeting,** Philadelphia Host Branch, and Golden Anniversary Educational Meeting and Banquet of Philadelphia Branch, Ben Franklin Hotel, Philadelphia, Pa.

February 19 & 21, 1960—**Executive Board Meeting,** Ben Franklin Hotel, Philadelphia, Pa.

April 8-9, 1960—**Executive Board Meeting,** National Headquarters, Newark, N. J.

April 23, 1960—**Sixth Tri-State Regional Meeting,** Cincinnati Host Branch, Sheraton-Gibson Hotel, Cincinnati, Ohio.

April 23, 1960—**Twenty-First Annual New England Regional Meeting,** Bridgeport Host Branch, Hotel Statler, Hartford, Conn.

April 29-30, 1960—**Sixth Empire State Regional,** Southern Tier Host Branch, Mark Twain Hotel, Elmira, N. Y.

July 24-28, 1960—**47th AES Annual Convention,** Hotel Statler, Los Angeles, Calif.

February 3-4, 1961—**Third Annual Dixie Regional Technical Session,** Hotel Roanoke, Roanoke, Virginia. Blue Ridge Host Branch.

June 18-23, 1961—**48th AES Annual Convention,** Hotel Statler, Boston, Mass.

June 25-28, 1962—**49th AES Annual Convention,** Schroeder Hotel, Milwaukee, Wis. Sponsorship Midwest Regional Council.

June 24-27, 1963—**50th AES Annual Convention,** Ambassador Hotel, Atlantic City. N. J. Sponsorship Newark Branch.

June 21-25, 1964—**51st AES Annual Convention,** St. Louis, Missouri

INTERSOCIETY

Nov. 30-Dec. 4, 1959—**27th Exposition of Chemical Industries,** New York Coliseum, New York City.

January 12-15, 1960—**Society of Plastics Engineers**—16th Annual Technical Conference, Conrad Hilton Hotel, Chicago, Ill.

January 26-27, 1960—**Society of Vacuum Coaters** Third Annual Meeting, Hotel Biltmore, New York City.

February 1-5, 1960—**American Society for Testing Materials,** Committee Week, Sherman Hotel, Chicago, Ill.

February 1-5, 1960—**Instrument Society of America,** Instrument-Automation Conference and Exhibit, Houston Coliseum, Houston, Texas.

March 14-18, 1960—**National Association of Corrosion Engineers,** 16th Annual Conference and 1960 Corrosion Show, Dallas, Texas.

May 1-5, 1960—**The Electrochemical Society,** Spring Meeting, LaSalle Hotel, Chicago, Ill.

May 9-13, 1960—**American Society for Metals,** 2nd Southwestern Metal Exposition and Congress, State Fair Park, Automobile Building, Dallas, Texas

June 26-July 1, 1960—**American Society for Testing Materials,** 63rd Annual Meeting (with Apparatus Exhibit), Chalfonte-Haddon Hall, Atlantic City, N. J.

July 24-26, 1960—**National Association of Metal Finishers,** 5th Anniversary and Membership Meeting, Hotel Statler, Los Angeles, California.

July 25-26, 1960—**National Association of Metal Finishers,** 5th Anniversary Management Seminar, Hotel Statler, Los Angeles, California.

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